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ARMY EPHEMERIS, 1979

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DEPARTMENT OF THE ARMY

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FIELD MANUAL

No. 6-300

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, 29 September 1978

ARMY EPHEMERIS 1979

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CHAPTER 1

INTRODUCTION

1-1. Purpose and Scope

a. This manual is a compilation of tables and charts for use in computing astronomical azimuths for the field artillery. These tables and charts are used for computing azimuth of the Sun or selected stars by either the altitude or hour-angle method. A special table (table 12), which is a tabular method of computing Polaris, is included for a rapid computation of a Polaris azimuth. The secant tables accompanying table 12 are permanent; however, the example portion of the explanatory part of the table will be updated annually. Tables and charts are also included to correct astronomic azimuth to grid azimuth, to extend azimuth by simultaneous observation and to perform zone-to-zone transformation of azimuth.

b. Data contained in tables 2, 10a, 10b, 11, and 12 are current only for the year in which the manual is effective. These tables are compiled annually by the Counterfire Department, under the supervision of the NOAA Liaison Officer, US Army Field Artillery School. The basic astronomical data is furnished by H.M. Nautical Almanac

Office, Royal Greenwich Observatory, and the Nautical Almanac Office, US Naval Observatory.

c. Users of this manual are encouraged to submit recommended changes or comments to improve the manual. Comments should be keyed to the specific page, paragraph, and line of the text in which the change is recommended. Reasons should be provided for each comment to insure understanding and complete evaluation. Comments should be prepared using DA Form 2028 (Recommended Changes to Publications and Blank Forms) and forwarded direct to the Commandant, US Army Field Artillery School, ATTN: ATSF-TD-TM, Fort Sill, Oklahoma 73503.

1-2. Description of Tables and Charts

This manual is intended to be used as a companion publication to FM 6-2, *Field Artillery Survey*. Details on the computation of astronomical azimuth and the use of these tables and charts are contained in FM 6-2.



CHAPTER 2

ASTRONOMICAL TABLES AND CHARTS

Table 1a. Astronomic Refraction Corrected for Temperature (Degrees)

TO BE SUBTRACTED FROM OBSERVED ALTITUDE OF SUN OR STAR

(Use values of observed altitude and temperature nearest the values tabulated as arguments.)

Observed altitude		Temperature °F.																
		-30	-20	-10	0	+10	+20	+30	+40	+50	+60	+70	+80	+90	+100	+110	+120	+130
00	00	40-43	39-45	38-53	38-02	37-15	36-27	35-44	35-01	34-20	33-40	33-01	32-26	31-51	31-36	30-43	30-14	29-49
	20	35-57	35-03	34-20	33-35	32-53	32-11	31-33	30-55	30-18	29-44	29-09	28-38	28-07	27-37	27-07	26-42	26-17
	40	32-00	31-15	30-34	29-54	29-18	28-39	28-05	27-31	26-59	26-28	25-57	25-30	25-02	24-35	24-09	23-46	23-23
01	00	28-42	28-01	27-25	26-49	26-15	25-42	25-12	24-41	24-12	23-44	23-17	22-52	22-27	22-03	21-40	21-19	20-59
	20	25-55	25-19	24-46	24-13	23-43	23-13	22-45	22-18	21-51	21-26	21-02	20-39	20-17	19-55	19-44	19-15	18-57
	40	23-34	23-00	22-31	22-01	21-33	21-03	20-41	20-16	19-52	19-29	19-07	18-46	18-28	18-03	17-47	17-30	17-13
02	00	21-32	21-02	20-35	20-07	19-42	19-17	18-54	18-31	18-10	17-49	17-28	17-10	16-51	16-33	16-15	16-00	15-45
	20	19-48	19-20	18-54	18-29	18-08	17-43	17-22	17-01	16-41	16-22	16-03	15-46	15-29	15-12	14-56	14-42	14-28
	40	18-17	17-51	17-28	17-05	16-43	16-22	16-03	15-43	15-25	15-07	14-50	14-34	14-18	14-02	13-48	13-35	13-22
03	00	16-57	16-33	16-12	15-50	15-30	15-11	14-53	14-35	14-18	14-01	13-45	13-30	13-16	13-01	12-48	12-36	12-24
	20	15-47	15-25	15-05	14-45	14-27	14-08	13-51	13-35	13-19	13-04	12-48	12-35	12-21	12-08	11-55	11-44	11-32
	40	14-45	14-25	14-03	13-47	13-30	13-13	12-57	12-42	12-27	12-12	11-58	11-46	11-33	11-20	11-08	10-58	10-47
04	00	13-50	13-31	13-13	12-56	12-40	12-24	12-09	11-54	11-40	11-27	11-14	11-02	10-50	10-38	10-27	10-17	10-07
	20	13-01	12-43	12-26	12-10	11-55	11-40	11-26	11-12	10-59	10-46	10-34	10-23	10-11	10-00	09-50	09-40	09-31
	40	12-17	12-00	11-44	11-29	11-14	11-00	10-47	10-34	10-22	10-10	09-58	09-47	09-37	09-28	09-16	09-08	08-59
05	00	11-38	11-21	11-07	10-52	10-38	10-25	10-13	10-00	09-48	09-37	09-28	09-16	09-03	08-58	08-47	08-38	08-30
	20	11-02	10-46	10-32	10-18	10-05	09-53	09-41	09-29	09-18	09-07	08-57	08-47	08-38	08-28	08-19	08-12	08-04
	40	10-29	10-14	10-01	09-48	09-35	09-23	09-12	09-01	08-50	08-40	08-30	08-21	08-12	08-03	07-55	07-47	07-40
06	00	09-59	09-45	09-32	09-20	09-08	08-56	08-46	08-35	08-25	08-16	08-03	07-57	07-49	07-40	07-32	07-25	07-18
	20	09-32	09-18	09-03	08-54	08-43	08-32	08-22	08-12	08-02	07-53	07-44	07-35	07-27	07-19	07-11	07-05	06-58
	40	09-07	08-54	08-42	08-31	08-20	08-09	08-00	07-50	07-41	07-32	07-23	07-16	07-08	07-00	06-53	06-46	06-40
07	00	08-43	08-31	08-20	08-09	07-59	07-49	07-39	07-30	07-21	07-13	07-05	06-57	06-50	06-42	06-35	06-29	06-23
	20	08-22	08-10	08-00	07-49	07-39	07-30	07-21	07-12	07-03	06-55	06-47	06-40	06-33	06-26	06-19	06-13	06-07
	40	08-02	07-51	07-41	07-31	07-21	07-12	07-03	06-55	06-47	06-39	06-31	06-24	06-17	06-10	06-04	05-58	05-53
08	00	07-44	07-33	07-23	07-13	07-04	06-55	06-47	06-39	06-31	06-24	06-16	06-10	06-03	05-56	05-50	05-45	05-39
	20	07-27	07-16	07-07	06-57	06-49	06-40	06-32	06-24	06-17	06-09	06-02	05-56	05-49	05-43	05-37	05-32	05-27
	40	07-11	07-01	06-52	06-42	06-34	06-26	06-18	06-10	06-03	05-56	05-49	05-43	05-37	05-31	05-25	05-20	05-15
09	00	06-53	06-46	06-37	06-28	06-20	06-12	06-05	05-58	05-51	05-44	05-37	05-31	05-25	05-19	05-14	05-09	05-04
	20	06-42	06-32	06-24	06-15	06-08	06-00	05-53	05-46	05-39	05-32	05-26	05-20	05-14	05-08	05-03	04-58	04-54
	40	06-29	06-19	06-11	06-03	05-56	05-48	05-41	05-34	05-28	05-21	05-15	05-10	05-04	04-59	04-53	04-49	04-44
10	00	06-18	06-07	06-00	05-52	05-44	05-37	05-30	05-24	05-17	05-11	05-05	05-00	04-54	04-49	04-44	04-40	04-36
	20	06-05	05-56	05-48	05-41	05-34	05-27	05-20	05-14	05-08	05-02	04-56	04-51	04-45	04-40	04-35	04-31	04-27
	40	05-54	05-45	05-38	05-30	05-24	05-17	05-10	05-04	04-58	04-53	04-47	04-42	04-37	04-32	04-27	04-23	04-19

Table 1a. Astronomic Refraction Corrected for Temperature (Degrees)—Continued

Observed altitude	Temperature °F.																
	-30	-20	-10	0	+10	+20	+30	+40	+50	+60	+70	+80	+90	+100	+110	+120	+130
11 00	05-43	05-35	05-28	05-21	05-14	05-07	05-01	04-55	04-50	04-44	04-39	04-34	04-29	04-24	04-19	04-15	04-11
20	05-34	05-26	05-19	05-12	05-05	04-59	04-53	04-47	04-41	04-36	04-31	04-26	04-21	04-16	04-12	04-08	04-04
40	05-24	05-17	05-10	05-03	04-57	04-50	04-45	04-39	04-33	04-28	04-23	04-18	04-14	04-09	04-05	04-01	03-57
12 00	05-15	05-08	05-01	04-55	04-49	04-42	04-37	04-31	04-26	04-21	04-16	04-11	04-07	04-02	03-58	03-54	03-51
20	05-07	05-00	04-53	04-47	04-41	04-35	04-30	04-24	04-19	04-14	04-09	04-05	04-00	03-55	03-52	03-48	03-44
40	04-59	04-52	04-46	04-39	04-34	04-28	04-21	04-17	04-12	04-07	04-03	03-58	03-54	03-50	03-46	03-42	03-39
13 00	04-51	04-45	04-38	04-32	04-27	04-21	04-16	04-11	04-06	04-01	03-56	03-52	03-48	03-44	03-40	03-36	03-33
20	04-44	04-37	04-31	04-25	04-20	04-14	04-09	04-04	04-00	03-55	03-50	03-46	03-42	03-38	03-34	03-31	03-27
40	04-37	04-31	04-25	04-19	04-14	04-08	04-03	03-58	03-54	03-49	03-45	03-41	03-37	03-33	03-29	03-26	03-23
14 00	04-31	04-24	04-19	04-13	04-08	04-02	03-58	03-53	03-48	03-44	03-40	03-36	03-32	03-28	03-24	03-21	03-19
20	04-24	04-18	04-12	04-07	04-02	03-57	03-52	03-47	03-43	03-39	03-34	03-31	03-27	03-23	03-19	03-16	03-13
40	04-18	04-12	04-07	04-01	03-56	03-51	03-47	03-41	03-38	03-34	03-29	03-26	03-22	03-18	03-15	03-12	03-09
15 00	04-12	04-06	04-01	03-56	03-51	03-46	03-42	03-37	03-33	03-29	03-25	03-21	03-17	03-14	03-10	03-07	03-04
20	04-07	04-01	03-56	03-51	03-46	03-41	03-37	03-32	03-28	03-24	03-20	03-17	03-13	03-10	03-06	03-03	03-00
40	04-01	03-55	03-51	03-46	03-41	03-36	03-32	03-28	03-24	03-20	03-16	03-12	03-09	03-05	03-02	02-59	02-57
16 00	03-56	03-51	03-46	03-41	03-36	03-32	03-27	03-23	03-19	03-15	03-12	03-08	03-05	03-01	02-58	02-55	02-53
20	03-51	03-46	03-41	03-36	03-32	03-27	03-23	03-19	03-15	03-12	03-08	03-04	03-01	02-58	02-55	02-52	02-49
40	03-47	03-41	03-36	03-32	03-27	03-23	03-19	03-15	03-11	03-07	03-04	03-00	02-57	02-54	02-51	02-48	02-46
17 00	03-42	03-37	03-32	03-27	03-23	03-19	03-15	03-11	03-07	03-04	03-00	02-57	02-54	02-51	02-48	02-45	02-42
20	03-38	03-32	03-28	03-23	03-19	03-15	03-11	03-07	03-03	03-00	02-56	02-53	02-50	02-47	02-44	02-42	02-39
40	03-33	03-28	03-24	03-19	03-15	03-11	03-07	03-03	03-00	02-56	02-53	02-50	02-47	02-44	02-41	02-38	02-36
18 00	03-29	03-24	03-20	03-15	03-11	03-07	03-04	03-00	02-56	02-53	02-50	02-47	02-44	02-41	02-38	02-35	02-33
20	03-25	03-20	03-16	03-12	03-08	03-04	03-00	02-56	02-53	02-50	02-46	02-43	02-41	02-38	02-35	02-32	02-30
40	03-21	03-17	03-12	03-08	03-04	03-00	02-57	02-53	02-50	02-46	02-43	02-40	02-37	02-35	02-32	02-30	02-27
19 00	03-18	03-13	03-09	03-05	03-01	02-57	02-53	02-50	02-47	02-43	02-40	02-37	02-35	02-32	02-29	02-27	02-24
20	03-14	03-09	03-05	03-01	02-58	02-54	02-50	02-47	02-44	02-40	02-37	02-35	02-32	02-29	02-26	02-24	02-22
40	03-10	03-06	03-02	02-58	02-54	02-51	02-47	02-44	02-41	02-38	02-34	02-32	02-29	02-26	02-24	02-21	02-19
20 00	03-07	03-03	02-59	02-55	02-51	02-48	02-44	02-41	02-38	02-35	02-32	02-29	02-26	02-24	02-21	02-19	02-17
20	03-04	02-59	02-55	02-52	02-48	02-45	02-41	02-38	02-35	02-32	02-29	02-26	02-24	02-21	02-19	02-17	02-14
40	03-01	02-56	02-53	02-49	02-45	02-42	02-39	02-35	02-32	02-29	02-27	02-24	02-21	02-19	02-16	02-14	02-12
21 00	02-58	02-53	02-50	02-46	02-42	02-39	02-36	02-33	02-30	02-27	02-24	02-21	02-19	02-16	02-14	02-12	02-10
20	02-55	02-50	02-47	02-43	02-40	02-36	02-33	02-30	02-27	02-24	02-22	02-19	02-17	02-14	02-12	02-10	02-08
40	02-52	02-48	02-44	02-40	02-37	02-34	02-31	02-28	02-25	02-22	02-19	02-17	02-14	02-12	02-10	02-07	02-05
22 00	02-49	02-45	02-41	02-38	02-34	02-31	02-28	02-25	02-22	02-20	02-17	02-14	02-12	02-10	02-07	02-05	02-03
20	02-46	02-42	02-39	02-35	02-32	02-29	02-26	02-23	02-20	02-17	02-15	02-12	02-10	02-08	02-05	02-03	02-01
40	02-43	02-40	02-36	02-33	02-30	02-26	02-23	02-21	02-18	02-15	02-13	02-10	02-08	02-06	02-03	02-01	01-59
23 00	02-41	02-37	02-34	02-30	02-27	02-24	02-21	02-18	02-16	02-13	02-10	02-08	02-06	02-04	02-01	01-59	01-58
20	02-38	02-34	02-31	02-28	02-25	02-22	02-19	02-16	02-13	02-11	02-08	02-06	02-04	02-02	01-59	01-58	01-56
40	02-35	02-32	02-29	02-26	02-23	02-20	02-17	02-14	02-11	02-09	02-06	02-04	02-02	02-00	01-58	01-56	01-54

Table 1a. Astronomic Refraction Corrected for Temperature (Degrees)—Continued

Observed altitude	Temperature °F.																
	-30	-20	-10	0	+10	+20	+30	+40	+50	+60	+70	+80	+90	+100	+110	+120	+130
24 00	02-33	02-30	02-28	02-23	02-20	02-17	02-15	02-12	02-09	02-07	02-04	02-02	02-00	01-58	01-56	01-54	01-52
24 20	02-31	02-28	02-24	02-21	02-18	02-15	02-13	02-10	02-07	02-05	02-03	02-00	01-58	01-56	01-54	01-52	01-50
24 40	02-29	02-25	02-22	02-19	02-16	02-13	02-11	02-08	02-05	02-03	02-01	01-59	01-56	01-54	01-52	01-50	01-49
25 00	02-28	02-23	02-20	02-17	02-14	02-11	02-09	02-08	02-04	02-01	01-59	01-57	01-55	01-53	01-51	01-49	01-47
25 20	02-24	02-21	02-18	02-15	02-12	02-09	02-07	02-04	02-02	02-00	01-57	01-55	01-53	01-51	01-49	01-47	01-46
25 40	02-22	02-19	02-16	02-13	02-10	02-07	02-05	02-02	02-00	01-58	01-55	01-53	01-51	01-49	01-47	01-46	01-44
26 00	02-20	02-17	02-14	02-11	02-08	02-05	02-03	02-01	01-58	01-56	01-54	01-52	01-50	01-48	01-46	01-44	01-42
26 20	02-18	02-15	02-12	02-09	02-06	02-04	02-01	01-59	01-56	01-54	01-52	01-50	01-48	01-46	01-44	01-43	01-41
26 40	02-16	02-13	02-10	02-07	02-05	02-02	02-00	01-57	01-55	01-53	01-50	01-48	01-47	01-45	01-43	01-41	01-40
27 00	02-14	02-11	02-08	02-06	02-03	02-00	01-58	01-55	01-53	01-51	01-49	01-47	01-45	01-43	01-41	01-40	01-38
27 20	02-12	02-09	02-06	02-04	02-01	01-59	01-56	01-54	01-52	01-49	01-47	01-45	01-44	01-42	01-40	01-38	01-37
27 40	02-10	02-07	02-05	02-02	01-59	01-57	01-55	01-52	01-50	01-48	01-46	01-44	01-42	01-40	01-38	01-37	01-35
28 00	02-09	02-06	02-03	02-00	01-58	01-55	01-53	01-51	01-48	01-46	01-44	01-43	01-41	01-39	01-37	01-35	01-34
28 20	02-07	02-04	02-01	01-59	01-56	01-54	01-51	01-49	01-47	01-45	01-43	01-41	01-39	01-37	01-35	01-34	01-33
28 40	02-05	02-02	02-00	01-57	01-54	01-52	01-50	01-48	01-46	01-43	01-41	01-40	01-38	01-36	01-34	01-33	01-31
29 00	02-03	02-01	01-58	01-55	01-53	01-51	01-48	01-46	01-44	01-42	01-40	01-38	01-37	01-35	01-33	01-32	01-30
29 20	02-02	01-59	01-56	01-54	01-51	01-49	01-47	01-45	01-43	01-41	01-39	01-37	01-35	01-34	01-32	01-30	01-29
29 40	02-00	01-57	01-55	01-52	01-50	01-48	01-45	01-43	01-41	01-39	01-37	01-36	01-34	01-32	01-31	01-29	01-28
30 00	01-59	01-56	01-53	01-51	01-48	01-46	01-44	01-42	01-40	01-38	01-36	01-34	01-33	01-31	01-30	01-28	01-27
30 20	01-57	01-54	01-52	01-49	01-47	01-45	01-43	01-41	01-39	01-37	01-35	01-33	01-32	01-30	01-28	01-27	01-25
30 40	01-55	01-53	01-50	01-48	01-46	01-43	01-41	01-39	01-37	01-36	01-34	01-32	01-30	01-29	01-27	01-26	01-24
31 00	01-54	01-51	01-49	01-46	01-44	01-42	01-40	01-38	01-36	01-34	01-32	01-31	01-29	01-28	01-26	01-25	01-23
31 20	01-52	01-50	01-47	01-45	01-43	01-41	01-39	01-37	01-35	01-33	01-31	01-30	01-28	01-26	01-25	01-24	01-22
31 40	01-51	01-48	01-46	01-44	01-42	01-39	01-37	01-35	01-34	01-32	01-30	01-28	01-27	01-25	01-24	01-22	01-21
32 00	01-50	01-47	01-45	01-42	01-40	01-38	01-36	01-34	01-32	01-31	01-29	01-27	01-26	01-24	01-23	01-21	01-20
32 20	01-48	01-45	01-43	01-40	01-38	01-36	01-34	01-33	01-31	01-29	01-27	01-26	01-24	01-23	01-21	01-20	01-19
33 00	01-45	01-43	01-41	01-39	01-36	01-34	01-33	01-31	01-29	01-27	01-26	01-24	01-22	01-21	01-20	01-18	01-17
33 20	01-44	01-41	01-39	01-37	01-35	01-33	01-31	01-29	01-27	01-26	01-24	01-22	01-21	01-20	01-18	01-17	01-16
34 00	01-42	01-39	01-37	01-35	01-33	01-31	01-29	01-27	01-26	01-24	01-22	01-21	01-19	01-18	01-17	01-15	01-14
34 20	01-40	01-37	01-35	01-33	01-31	01-29	01-28	01-26	01-24	01-23	01-21	01-19	01-18	01-17	01-15	01-14	01-13
35 00	01-38	01-36	01-33	01-31	01-30	01-28	01-26	01-24	01-22	01-21	01-19	01-18	01-17	01-15	01-14	01-13	01-12
35 20	01-36	01-34	01-32	01-30	01-28	01-26	01-24	01-23	01-21	01-19	01-18	01-17	01-15	01-14	01-12	01-11	01-10
36 00	01-34	01-32	01-30	01-28	01-26	01-24	01-23	01-21	01-20	01-18	01-16	01-15	01-14	01-12	01-11	01-10	01-09
36 20	01-33	01-30	01-28	01-27	01-25	01-23	01-21	01-20	01-18	01-17	01-15	01-14	01-12	01-11	01-10	01-09	01-08
37 00	01-31	01-29	01-27	01-25	01-23	01-21	01-20	01-18	01-17	01-15	01-14	01-12	01-11	01-10	01-09	01-08	01-07
37 20	01-29	01-27	01-25	01-23	01-22	01-20	01-18	01-17	01-15	01-14	01-12	01-11	01-10	01-09	01-07	01-06	01-05

Table 1a. Astronomic Refraction Corrected for Temperature (Degrees)—Continued

Observed altitude	Temperature °F.																
	-30	-20	-10	0	+10	+20	+30	+40	+50	+60	+70	+80	+90	+100	+110	+120	+130
' "	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "
38 00	01-28	01-23	01-24	01-22	01-20	01-19	01-17	01-15	01-14	01-13	01-11	01-10	01-09	01-07	01-03	01-05	01-04
30	01-23	01-24	01-22	01-21	01-19	01-17	01-16	01-14	01-13	01-11	01-10	01-09	01-07	01-03	01-05	01-04	01-03
39 00	01-25	01-23	01-21	01-19	01-17	01-16	01-14	01-13	01-11	01-10	01-09	01-07	01-03	01-05	01-04	01-03	01-02
30	01-23	01-21	01-19	01-18	01-16	01-14	01-13	01-12	01-10	01-09	01-07	01-03	01-05	01-04	01-03	01-02	01-01
40 00	01-22	01-20	01-18	01-16	01-15	01-13	01-12	01-10	01-09	01-08	01-06	01-05	01-04	01-03	01-02	01-01	01-00
30	01-20	01-18	01-17	01-15	01-13	01-12	01-10	01-09	01-08	01-06	01-05	01-04	01-03	01-02	01-01	01-00	00-59
41 00	01-19	01-17	01-15	01-14	01-12	01-11	01-09	01-09	01-08	01-05	01-04	01-03	01-02	01-01	01-00	00-59	00-58
30	01-18	01-16	01-14	01-12	01-11	01-09	01-08	01-07	01-05	01-04	01-03	01-02	01-01	01-00	00-59	00-58	00-57
42 00	01-16	01-14	01-13	01-11	01-10	01-08	01-07	01-05	01-04	01-03	01-02	01-01	01-00	00-58	00-57	00-57	00-56
30	01-15	01-13	01-11	01-10	01-08	01-07	01-03	01-04	01-03	01-02	01-01	01-00	00-59	00-57	00-56	00-56	00-55
43 00	01-14	01-12	01-10	01-09	01-07	01-03	01-05	01-03	01-02	01-01	01-00	00-59	00-58	00-56	00-55	00-55	00-54
30	01-12	01-11	01-09	01-08	01-03	01-05	01-04	01-02	01-01	01-00	00-59	00-58	00-57	00-56	00-55	00-54	00-53
44 00	01-11	01-09	01-08	01-06	01-05	01-04	01-02	01-01	01-00	00-59	00-58	00-57	00-56	00-55	00-54	00-53	00-52
30	01-10	01-08	01-07	01-05	01-04	01-03	01-01	01-00	00-59	00-58	00-57	00-56	00-55	00-54	00-53	00-52	00-51
45 00	01-09	01-07	01-03	01-04	01-03	01-01	01-00	00-59	00-58	00-57	00-56	00-55	00-54	00-53	00-52	00-51	00-50
30	01-07	01-03	01-04	01-03	01-02	01-00	00-59	00-58	00-57	00-56	00-55	00-54	00-53	00-52	00-51	00-50	00-49
46 00	01-03	01-05	01-03	01-02	01-01	00-59	00-58	00-57	00-56	00-55	00-54	00-53	00-52	00-51	00-50	00-49	00-48
30	01-05	01-04	01-02	01-01	01-00	00-58	00-57	00-56	00-55	00-54	00-53	00-52	00-51	00-50	00-49	00-48	00-48
47 00	01-04	01-03	01-01	01-00	00-59	00-57	00-56	00-55	00-54	00-53	00-52	00-51	00-50	00-49	00-48	00-48	00-47
30	01-03	01-01	01-00	00-59	00-58	00-56	00-55	00-54	00-53	00-52	00-51	00-50	00-49	00-48	00-47	00-47	00-46
48 00	01-02	01-00	00-59	00-58	00-57	00-55	00-54	00-53	00-52	00-51	00-50	00-49	00-48	00-47	00-47	00-46	00-45
30	01-01	00-59	00-58	00-57	00-56	00-54	00-53	00-52	00-51	00-50	00-49	00-48	00-48	00-47	00-46	00-45	00-44
49 00	01-00	00-58	00-57	00-56	00-55	00-53	00-52	00-51	00-50	00-49	00-48	00-48	00-47	00-46	00-45	00-44	00-44
30	00-59	00-57	00-56	00-55	00-54	00-52	00-51	00-50	00-49	00-48	00-48	00-47	00-46	00-45	00-44	00-44	00-43
50 00	00-58	00-56	00-55	00-54	00-53	00-52	00-51	00-50	00-49	00-48	00-47	00-46	00-45	00-44	00-43	00-43	00-42
51 00	00-58	00-54	00-53	00-52	00-51	00-50	00-49	00-48	00-47	00-46	00-45	00-44	00-44	00-43	00-42	00-41	00-41
52 00	00-54	00-52	00-51	00-50	00-49	00-48	00-47	00-46	00-45	00-44	00-43	00-43	00-42	00-41	00-40	00-40	00-39
53 00	00-52	00-50	00-49	00-48	00-47	00-46	00-45	00-44	00-44	00-43	00-42	00-41	00-40	00-40	00-39	00-38	00-38
54 00	00-50	00-49	00-48	00-47	00-46	00-45	00-44	00-43	00-42	00-41	00-41	00-40	00-39	00-38	00-38	00-37	00-37
55 00	00-48	00-47	00-46	00-45	00-44	00-43	00-42	00-41	00-40	00-40	00-39	00-38	00-38	00-37	00-36	00-36	00-35
56 00	00-46	00-45	00-44	00-43	00-42	00-41	00-41	00-40	00-39	00-38	00-38	00-37	00-36	00-36	00-35	00-34	00-34
57 00	00-45	00-44	00-43	00-42	00-41	00-40	00-39	00-38	00-38	00-37	00-36	00-36	00-35	00-34	00-34	00-33	00-33

Table 1a. Astronomic Refraction Corrected for Temperature (Degrees)—Continued

Observed altitude	Temperature °F.																
	-30	-20	-10	0	+10	+20	+30	+40	+50	+60	+70	+80	+90	+100	+110	+120	+130
' "	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "
58 00	00-43	00-42	00-41	00-40	00-39	00-38	00-38	00-37	00-36	00-36	00-35	00-34	00-34	00-33	00-32	00-32	00-31
59 00	00-41	00-40	00-39	00-39	00-38	00-37	00-36	00-35	00-35	00-34	00-33	00-33	00-32	00-32	00-31	00-31	00-30
60 00	00-40	00-39	00-38	00-37	00-36	00-35	00-35	00-34	00-33	00-33	00-32	00-32	00-31	00-30	00-30	00-29	00-29

Table 1b. Astronomic Refraction Corrected for Temperature (Mils)

TO BE SUBTRACTED FROM OBSERVED ALTITUDE OF SUN OR STAR

(Use values of observed altitude and temperature nearest the values tabulated as arguments.)

Observed altitude	Temperature °F.																
	-30	-20	-10	0	+10	+20	+30	+40	+50	+60	+70	+80	+90	+100	+110	+120	+130
h	h	h	h	h	h	h	h	h	h	h	h	h	h	h	h	h	h
0	12.65	12.35	12.08	11.82	11.57	11.33	11.10	10.88	10.66	10.46	10.26	10.06	9.90	9.72	9.54	9.40	9.25
10	9.83	9.60	9.39	9.18	8.99	8.80	8.63	8.45	8.29	8.13	7.97	7.83	7.69	7.55	7.42	7.30	7.19
20	8.18	7.99	7.82	7.64	7.49	7.33	7.21	7.04	6.90	6.77	6.64	6.52	6.40	6.28	6.17	6.08	5.98
30	6.94	6.78	6.63	6.49	6.35	6.22	6.09	5.97	5.85	5.74	5.63	5.53	5.43	5.33	5.24	5.16	5.08
40	5.99	5.85	5.72	5.60	5.48	5.36	5.26	5.15	5.05	4.95	4.86	4.77	4.69	4.60	4.52	4.45	4.38
50	5.24	5.11	5.00	4.89	4.79	4.69	4.60	4.50	4.42	4.33	4.25	4.17	4.10	4.02	3.95	3.89	3.83
60	4.64	4.53	4.43	4.33	4.24	4.15	4.07	3.99	3.91	3.84	3.76	3.70	3.63	3.56	3.50	3.45	3.39
70	4.15	4.05	3.96	3.88	3.80	3.72	3.64	3.57	3.50	3.43	3.37	3.31	3.25	3.19	3.13	3.08	3.03
80	3.75	3.66	3.58	3.50	3.43	3.35	3.29	3.22	3.16	3.10	3.04	2.99	2.93	2.88	2.83	2.78	2.74
90	3.41	3.33	3.26	3.19	3.12	3.06	2.99	2.93	2.88	2.82	2.77	2.72	2.67	2.62	2.57	2.53	2.46
100	3.13	3.05	2.99	2.92	2.86	2.80	2.74	2.69	2.64	2.59	2.54	2.49	2.45	2.40	2.36	2.32	2.28
110	2.88	2.81	2.75	2.69	2.64	2.58	2.53	2.48	2.43	2.38	2.34	2.30	2.25	2.21	2.17	2.14	2.11
120	2.67	2.61	2.55	2.49	2.44	2.39	2.34	2.30	2.25	2.21	2.17	2.13	2.09	2.05	2.01	1.98	1.95
130	2.49	2.43	2.37	2.32	2.27	2.22	2.18	2.14	2.10	2.06	2.02	1.98	1.94	1.91	1.88	1.85	1.82
140	2.32	2.27	2.22	2.17	2.13	2.08	2.04	2.00	1.96	1.92	1.88	1.85	1.82	1.79	1.75	1.73	1.70
150	2.18	2.13	2.08	2.04	2.00	1.95	1.91	1.88	1.84	1.80	1.77	1.74	1.71	1.68	1.65	1.62	1.59
160	2.05	2.00	1.96	1.92	1.88	1.84	1.80	1.77	1.73	1.70	1.67	1.64	1.61	1.58	1.55	1.53	1.50
170	1.94	1.89	1.85	1.81	1.77	1.74	1.70	1.67	1.64	1.60	1.57	1.55	1.52	1.49	1.46	1.44	1.42
180	1.84	1.79	1.75	1.72	1.68	1.64	1.61	1.58	1.55	1.52	1.49	1.46	1.44	1.41	1.39	1.36	1.34
190	1.74	1.70	1.67	1.63	1.59	1.56	1.53	1.50	1.47	1.44	1.41	1.39	1.36	1.34	1.32	1.29	1.27
200	1.66	1.62	1.58	1.55	1.52	1.49	1.46	1.43	1.40	1.37	1.35	1.32	1.30	1.27	1.25	1.23	1.21
210	1.58	1.54	1.51	1.48	1.45	1.42	1.39	1.36	1.33	1.31	1.28	1.26	1.24	1.22	1.19	1.18	1.16
220	1.51	1.48	1.44	1.41	1.38	1.35	1.33	1.30	1.27	1.25	1.23	1.20	1.18	1.16	1.14	1.12	1.10
230	1.45	1.41	1.38	1.35	1.32	1.29	1.27	1.25	1.22	1.20	1.17	1.15	1.13	1.11	1.09	1.07	1.06
240	1.39	1.35	1.32	1.29	1.27	1.24	1.22	1.19	1.17	1.15	1.12	1.10	1.08	1.06	1.05	1.03	1.01
250	1.33	1.30	1.27	1.24	1.22	1.19	1.17	1.14	1.12	1.10	1.08	1.06	1.04	1.02	1.00	0.99	0.97
260	1.28	1.25	1.22	1.19	1.17	1.14	1.12	1.10	1.08	1.06	1.04	1.02	1.00	0.98	0.96	0.95	0.93
270	1.23	1.20	1.18	1.15	1.13	1.10	1.08	1.06	1.04	1.02	0.99	0.98	0.96	0.95	0.93	0.91	0.90
280	1.19	1.16	1.13	1.11	1.09	1.06	1.04	1.02	1.00	0.98	0.96	0.94	0.93	0.91	0.90	0.88	0.87
290	1.14	1.12	1.09	1.07	1.05	1.02	1.00	0.98	0.96	0.95	0.93	0.91	0.89	0.88	0.86	0.85	0.84
300	1.10	1.08	1.06	1.03	1.01	0.99	0.97	0.95	0.93	0.91	0.90	0.88	0.86	0.85	0.83	0.82	0.81
310	1.07	1.04	1.02	1.00	0.98	0.96	0.94	0.92	0.90	0.88	0.87	0.85	0.84	0.82	0.81	0.79	0.78
320	1.03	1.01	0.99	0.96	0.94	0.92	0.91	0.89	0.87	0.85	0.84	0.82	0.81	0.79	0.78	0.77	0.75
330	1.00	0.98	0.96	0.93	0.92	0.90	0.88	0.86	0.84	0.83	0.81	0.80	0.78	0.77	0.75	0.74	0.73
340	0.97	0.95	0.93	0.91	0.89	0.87	0.85	0.83	0.82	0.80	0.79	0.77	0.76	0.74	0.73	0.72	0.71

Table 1b. Astronomic Refraction Corrected for Temperature (Mils)—Continued

Observed altitude	Temperature °F.																
	-30	-20	-10	0	+10	+20	+30	+40	+50	+60	+70	+80	+90	+100	+110	+120	+130
n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
350	0.94	0.92	0.90	0.88	0.86	0.84	0.82	0.81	0.79	0.78	0.76	0.75	0.74	0.72	0.71	0.70	0.69
360	0.91	0.89	0.87	0.85	0.83	0.82	0.80	0.78	0.77	0.75	0.74	0.73	0.71	0.70	0.69	0.68	0.67
370	0.89	0.86	0.85	0.83	0.81	0.79	0.78	0.76	0.75	0.73	0.72	0.71	0.69	0.68	0.67	0.66	0.65
380	0.86	0.84	0.82	0.80	0.79	0.77	0.76	0.74	0.73	0.71	0.70	0.69	0.67	0.66	0.65	0.64	0.63
390	0.84	0.82	0.80	0.78	0.77	0.75	0.73	0.72	0.71	0.69	0.68	0.67	0.65	0.64	0.63	0.62	0.61
400	0.81	0.79	0.78	0.76	0.74	0.73	0.71	0.70	0.69	0.67	0.66	0.65	0.64	0.62	0.61	0.60	0.59
410	0.79	0.77	0.76	0.74	0.72	0.71	0.70	0.68	0.67	0.65	0.64	0.63	0.62	0.61	0.60	0.59	0.58
420	0.77	0.75	0.74	0.72	0.71	0.69	0.68	0.66	0.65	0.64	0.63	0.61	0.60	0.59	0.58	0.57	0.56
430	0.75	0.73	0.72	0.70	0.69	0.67	0.66	0.65	0.63	0.62	0.61	0.60	0.59	0.58	0.57	0.56	0.55
440	0.73	0.71	0.70	0.68	0.67	0.66	0.64	0.63	0.62	0.61	0.59	0.58	0.57	0.56	0.55	0.54	0.54
450	0.71	0.70	0.68	0.67	0.65	0.64	0.63	0.61	0.60	0.59	0.58	0.57	0.56	0.55	0.54	0.53	0.52
460	0.70	0.68	0.66	0.65	0.64	0.62	0.61	0.60	0.59	0.58	0.56	0.55	0.54	0.53	0.53	0.52	0.51
470	0.68	0.66	0.65	0.64	0.62	0.61	0.60	0.58	0.57	0.56	0.55	0.54	0.53	0.52	0.51	0.50	0.50
480	0.66	0.65	0.63	0.62	0.61	0.59	0.58	0.57	0.56	0.55	0.54	0.53	0.52	0.51	0.50	0.49	0.48
490	0.65	0.63	0.62	0.60	0.59	0.58	0.57	0.56	0.55	0.54	0.52	0.52	0.51	0.50	0.49	0.48	0.47
500	0.63	0.62	0.60	0.59	0.58	0.57	0.55	0.54	0.53	0.52	0.51	0.50	0.49	0.49	0.48	0.47	0.46
510	0.62	0.62	0.59	0.58	0.56	0.55	0.54	0.53	0.52	0.51	0.50	0.49	0.48	0.47	0.47	0.46	0.45
520	0.60	0.59	0.58	0.56	0.55	0.54	0.53	0.52	0.51	0.50	0.49	0.48	0.47	0.46	0.46	0.45	0.44
530	0.59	0.58	0.56	0.55	0.54	0.53	0.52	0.51	0.50	0.49	0.48	0.47	0.46	0.45	0.45	0.44	0.43
540	0.58	0.56	0.55	0.54	0.53	0.52	0.51	0.50	0.49	0.48	0.47	0.46	0.45	0.44	0.43	0.43	0.42
550	0.56	0.55	0.54	0.53	0.52	0.51	0.50	0.49	0.48	0.47	0.46	0.45	0.44	0.43	0.42	0.42	0.41
560	0.55	0.54	0.53	0.52	0.50	0.49	0.48	0.47	0.47	0.46	0.45	0.44	0.43	0.42	0.42	0.41	0.40
570	0.54	0.53	0.52	0.50	0.49	0.48	0.47	0.46	0.46	0.45	0.44	0.43	0.42	0.41	0.41	0.40	0.39
580	0.53	0.52	0.50	0.49	0.48	0.47	0.46	0.45	0.45	0.44	0.43	0.42	0.41	0.41	0.40	0.39	0.39
590	0.52	0.50	0.49	0.48	0.47	0.46	0.45	0.44	0.44	0.43	0.42	0.41	0.40	0.40	0.39	0.38	0.38
600	0.51	0.49	0.48	0.47	0.46	0.45	0.44	0.44	0.43	0.42	0.41	0.40	0.40	0.39	0.38	0.38	0.37
610	0.50	0.48	0.47	0.46	0.45	0.44	0.44	0.43	0.42	0.41	0.40	0.40	0.39	0.38	0.37	0.37	0.36
620	0.49	0.47	0.46	0.45	0.44	0.43	0.43	0.42	0.41	0.40	0.39	0.39	0.38	0.37	0.37	0.36	0.35
630	0.48	0.46	0.45	0.44	0.44	0.43	0.42	0.41	0.40	0.39	0.39	0.38	0.37	0.37	0.36	0.35	0.35
640	0.47	0.45	0.44	0.43	0.43	0.42	0.41	0.40	0.39	0.39	0.38	0.37	0.36	0.36	0.35	0.35	0.34
650	0.46	0.45	0.44	0.43	0.42	0.41	0.40	0.39	0.38	0.38	0.37	0.36	0.36	0.35	0.34	0.34	0.33
660	0.45	0.44	0.43	0.42	0.41	0.40	0.39	0.38	0.38	0.37	0.36	0.36	0.35	0.34	0.34	0.33	0.33
670	0.44	0.43	0.42	0.41	0.40	0.39	0.38	0.38	0.37	0.36	0.36	0.35	0.34	0.34	0.33	0.33	0.32
680	0.43	0.42	0.41	0.40	0.39	0.39	0.38	0.37	0.36	0.36	0.35	0.34	0.34	0.33	0.32	0.32	0.31
690	0.42	0.41	0.40	0.39	0.39	0.38	0.37	0.36	0.36	0.35	0.34	0.34	0.33	0.32	0.32	0.31	0.31
700	0.41	0.40	0.39	0.39	0.38	0.37	0.36	0.36	0.35	0.34	0.33	0.33	0.32	0.32	0.31	0.31	0.30
710	0.40	0.40	0.39	0.38	0.37	0.36	0.36	0.35	0.34	0.33	0.33	0.32	0.32	0.31	0.31	0.30	0.30
720	0.40	0.39	0.38	0.37	0.36	0.36	0.35	0.34	0.33	0.33	0.32	0.32	0.31	0.30	0.30	0.29	0.29
730	0.39	0.38	0.37	0.36	0.36	0.35	0.34	0.33	0.33	0.32	0.31	0.31	0.30	0.30	0.29	0.29	0.28
740	0.38	0.37	0.36	0.36	0.35	0.34	0.33	0.33	0.32	0.32	0.31	0.30	0.30	0.29	0.29	0.28	0.28
750	0.37	0.36	0.36	0.35	0.34	0.33	0.33	0.32	0.32	0.31	0.30	0.30	0.29	0.29	0.28	0.28	0.27
760	0.37	0.36	0.35	0.34	0.34	0.33	0.32	0.32	0.31	0.30	0.30	0.29	0.29	0.28	0.28	0.27	0.27
770	0.36	0.35	0.34	0.34	0.33	0.32	0.32	0.31	0.30	0.30	0.29	0.29	0.28	0.28	0.27	0.27	0.26
780	0.35	0.34	0.34	0.33	0.32	0.32	0.31	0.30	0.30	0.29	0.29	0.28	0.28	0.27	0.27	0.26	0.26

Table 1b. Astronomic Refraction Corrected for Temperature (Mils)—Continued

Observed altitude	Temperature °F.																
	-30	-20	-10	0	+10	+20	+30	+40	+50	+60	+70	+80	+90	+100	+110	+120	+130
m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m
790	0.35	0.34	0.33	0.32	0.32	0.31	0.30	0.30	0.29	0.29	0.28	0.28	0.27	0.27	0.26	0.26	0.25
800	0.34	0.33	0.32	0.32	0.31	0.30	0.30	0.29	0.29	0.28	0.28	0.27	0.27	0.26	0.26	0.25	0.25
810	0.33	0.32	0.32	0.31	0.30	0.30	0.29	0.29	0.28	0.27	0.27	0.26	0.26	0.25	0.25	0.24	0.24
820	0.33	0.32	0.31	0.30	0.30	0.29	0.29	0.28	0.27	0.27	0.26	0.26	0.25	0.25	0.25	0.24	0.24
830	0.32	0.31	0.31	0.30	0.29	0.29	0.28	0.28	0.27	0.26	0.26	0.25	0.25	0.25	0.24	0.24	0.23
840	0.31	0.31	0.30	0.29	0.29	0.28	0.27	0.27	0.26	0.26	0.25	0.25	0.24	0.24	0.24	0.23	0.23
850	0.31	0.30	0.29	0.29	0.28	0.27	0.27	0.26	0.26	0.25	0.25	0.24	0.24	0.24	0.23	0.23	0.22
860	0.30	0.29	0.29	0.28	0.28	0.27	0.26	0.26	0.25	0.25	0.24	0.24	0.24	0.23	0.23	0.22	0.22
870	0.30	0.29	0.28	0.28	0.27	0.26	0.26	0.25	0.25	0.24	0.24	0.24	0.23	0.23	0.22	0.22	0.22
880	0.29	0.28	0.28	0.27	0.26	0.25	0.25	0.25	0.24	0.24	0.23	0.23	0.23	0.22	0.22	0.21	0.21
890	0.28	0.28	0.27	0.27	0.26	0.25	0.25	0.24	0.24	0.23	0.23	0.23	0.22	0.22	0.21	0.21	0.21
900	0.28	0.27	0.27	0.26	0.25	0.25	0.24	0.24	0.23	0.23	0.23	0.22	0.22	0.21	0.21	0.21	0.20
910	0.27	0.27	0.26	0.25	0.25	0.24	0.24	0.23	0.23	0.23	0.22	0.22	0.21	0.21	0.21	0.20	0.20
920	0.27	0.26	0.26	0.25	0.24	0.24	0.23	0.23	0.23	0.22	0.22	0.21	0.21	0.21	0.20	0.20	0.20
930	0.26	0.26	0.25	0.24	0.24	0.23	0.23	0.23	0.22	0.22	0.21	0.21	0.20	0.20	0.20	0.19	0.19
940	0.26	0.25	0.25	0.24	0.24	0.23	0.23	0.22	0.22	0.21	0.21	0.20	0.20	0.20	0.19	0.19	0.19
950	0.25	0.25	0.24	0.23	0.23	0.22	0.22	0.22	0.21	0.21	0.20	0.20	0.20	0.19	0.19	0.19	0.18
960	0.25	0.24	0.24	0.23	0.23	0.22	0.22	0.21	0.21	0.20	0.20	0.20	0.19	0.19	0.19	0.18	0.18
970	0.24	0.24	0.23	0.23	0.22	0.22	0.21	0.21	0.20	0.20	0.20	0.19	0.19	0.19	0.18	0.18	0.18
980	0.24	0.23	0.23	0.22	0.22	0.21	0.21	0.20	0.20	0.20	0.19	0.19	0.19	0.18	0.18	0.18	0.17
990	0.23	0.23	0.22	0.22	0.21	0.21	0.20	0.20	0.20	0.19	0.19	0.18	0.18	0.18	0.17	0.17	0.17
1000	0.23	0.22	0.22	0.21	0.21	0.20	0.20	0.19	0.19	0.19	0.18	0.18	0.18	0.17	0.17	0.17	0.17
1010	0.22	0.22	0.21	0.21	0.20	0.20	0.19	0.19	0.19	0.18	0.18	0.18	0.17	0.17	0.17	0.16	0.16
1020	0.22	0.21	0.21	0.20	0.20	0.19	0.19	0.19	0.18	0.18	0.18	0.17	0.17	0.17	0.16	0.16	0.16
1030	0.21	0.21	0.20	0.20	0.19	0.19	0.19	0.18	0.18	0.18	0.17	0.17	0.17	0.16	0.16	0.16	0.16
1040	0.21	0.20	0.20	0.19	0.19	0.19	0.18	0.18	0.18	0.17	0.17	0.17	0.16	0.16	0.16	0.15	0.15
1050	0.20	0.20	0.19	0.19	0.19	0.18	0.18	0.17	0.17	0.17	0.16	0.16	0.16	0.15	0.15	0.15	0.15
1060	0.20	0.19	0.19	0.19	0.18	0.18	0.17	0.17	0.17	0.16	0.16	0.16	0.16	0.15	0.15	0.15	0.15
1070	0.19	0.19	0.19	0.18	0.18	0.17	0.17	0.17	0.16	0.16	0.16	0.15	0.15	0.15	0.15	0.14	0.14
1080	0.19	0.19	0.18	0.18	0.17	0.17	0.17	0.16	0.16	0.16	0.15	0.15	0.15	0.15	0.14	0.14	0.14
1090	0.19	0.18	0.18	0.17	0.17	0.17	0.16	0.16	0.16	0.15	0.15	0.15	0.15	0.14	0.14	0.14	0.14
1100	0.18	0.18	0.17	0.17	0.17	0.16	0.16	0.16	0.15	0.15	0.15	0.14	0.14	0.14	0.14	0.13	0.13
1110	0.18	0.17	0.17	0.17	0.16	0.16	0.16	0.15	0.15	0.15	0.14	0.14	0.14	0.14	0.13	0.13	0.13
1120	0.17	0.17	0.17	0.16	0.16	0.15	0.15	0.15	0.15	0.14	0.14	0.14	0.14	0.13	0.13	0.13	0.13
1130	0.17	0.16	0.16	0.16	0.15	0.15	0.15	0.15	0.14	0.14	0.14	0.13	0.13	0.13	0.13	0.13	0.12
1140	0.16	0.16	0.16	0.15	0.15	0.15	0.14	0.14	0.14	0.14	0.13	0.13	0.13	0.13	0.12	0.12	0.12
1150	0.16	0.16	0.15	0.15	0.15	0.14	0.14	0.14	0.14	0.13	0.13	0.13	0.13	0.12	0.12	0.12	0.12
1160	0.16	0.15	0.15	0.15	0.14	0.14	0.14	0.13	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.12	0.11
1170	0.15	0.15	0.15	0.14	0.14	0.14	0.13	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.11	0.11	0.11
1180	0.15	0.15	0.14	0.14	0.14	0.13	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.11	0.11	0.11	0.11
1190	0.14	0.14	0.14	0.14	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.12	0.11	0.11	0.11	0.11	0.11
1200	0.14	0.14	0.13	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.11	0.11	0.11	0.11	0.10	0.10	0.10

Table 1c. Pressure Correction Factor, C_B

(Apply to values in tables 1a or 1b)

Barometer		C_B	Barometer		C_B	Barometer		C_B
Inches	Millibars		Inches	Millibars		Inches	Millibars	
20.0	677	0.670	23.8	806	0.796	27.4	928	0.916
20.1	681	0.673	23.9	809	0.799	27.5	931	0.920
20.2	684	0.676				27.6	935	0.923
20.3	687	0.679	23.9	809	0.799	27.7	938	0.926
20.4	691	0.682	24.0	818	0.808	27.8	941	0.929
			24.1	816	0.806			
20.5	694	0.685	24.2	820	0.809	27.8	941	0.929
20.6	698	0.688	24.3	823	0.818	27.9	945	0.933
20.7	701	0.692				28.0	948	0.936
20.8	704	0.696	24.4	826	0.816	28.1	952	0.939
20.9	708	0.699	24.5	830	0.820	28.2	955	0.942
			24.6	833	0.823			
21.0	711	0.703	24.7	836	0.826	28.3	958	0.946
21.1	715	0.706	24.8	840	0.829	28.4	962	0.949
21.2	718	0.709				28.5	965	0.953
21.3	721	0.712	24.9	843	0.832	28.6	969	0.956
21.4	725	0.716	25.0	847	0.835	28.7	972	0.959
			25.1	850	0.838			
21.5	728	0.719	25.2	853	0.842	28.8	975	0.963
21.6	731	0.722	25.3	857	0.846	28.9	979	0.966
21.7	735	0.725				29.0	982	0.970
21.8	738	0.729	25.4	860	0.849	29.1	985	0.973
21.9	742	0.732	25.5	864	0.853	29.2	989	0.976
			25.6	867	0.856			
22.0	745	0.735	25.7	870	0.859	29.3	992	0.979
22.1	748	0.739	25.8	874	0.862	29.4	996	0.983
22.2	752	0.742				29.5	999	0.986
22.3	755	0.746	25.9	877	0.866	29.6	1002	0.989
22.4	759	0.749	26.0	880	0.869	29.7	1006	0.992
			26.1	884	0.872			
22.5	762	0.752	26.2	887	0.875	29.8	1009	0.996
22.6	765	0.755	26.3	891	0.879	29.9	1013	0.999
22.7	769	0.759				30.0	1016	1.003
22.8	772	0.762	26.4	894	0.882	30.1	1019	1.007
22.9	775	0.766	26.5	897	0.885	30.2	1023	1.010
			26.6	901	0.889			
23.0	779	0.770	26.7	904	0.892	30.3	1026	1.013
23.1	782	0.773	26.8	908	0.896	30.4	1029	1.016
23.2	786	0.776				30.5	1033	1.020
23.3	789	0.779	26.9	911	0.899	30.6	1036	1.023
23.4	792	0.783	27.0	914	0.902	30.7	1040	1.026
			27.1	918	0.905			
23.5	796	0.786	27.2	921	0.909	30.8	1043	1.029
23.6	799	0.789	27.3	924	0.912	30.9	1046	1.033
23.7	803	0.792				31.0	1050	1.036

Note. Omit Pressure Correction Factor for artillery surveys of fourth-order (1:3000) or lesser accuracies.

Table 2. Sun, 1979, for Zero Hours Universal Time (GMT)

GREENWICH DATE	APPARENT DECLINATION					EQUATION OF TIME			SIDERAL TIME		
	DEGREES			MILS		MIN	SEC	DAILY CHANGE (SEC)	HR	MIN	SEC
	0	/	//	DAILY CHANGE (SEC)	DAILY CHANGE (MILS)						
JAN 0 SU	-23	8	14	+ 260	- 411.33 + 1.29	- 2	40.5	- 28.8	6	36	15.9
1 MO	-23	3	54	+ 289	- 410.04 + 1.42	- 3	9.4	- 28.5	6	40	12.4
2 TU	-22	59	5	+ 315	- 408.62 + 1.56	- 3	37.9	- 28.2	6	44	9.0
3 WF	-22	53	50	+ 344	- 407.06 + 1.70	- 4	6.1	- 27.8	6	48	5.5
4 TH	-22	48	6	+ 370	- 405.36 + 1.82	- 4	33.9	- 27.4	6	52	2.1
5 FR	-22	41	56	+ 397	- 403.54 + 1.97	- 5	1.2	- 27.0	6	55	58.6
6 SA	-22	35	19	+ 424	- 401.57 + 2.09	- 5	28.2	- 26.5	6	59	55.2
7 SU	-22	28	15	+ 451	- 399.48 + 2.22	- 5	54.7	- 26.0	7	3	51.7
8 MO	-22	20	44	+ 477	- 397.26 + 2.36	- 6	20.7	- 25.5	7	7	48.3
9 TU	-22	12	47	+ 503	- 394.90 + 2.49	- 6	46.2	- 24.9	7	11	44.9
10 WF	-22	4	24	+ 529	- 392.41 + 2.61	- 7	11.1	- 24.4	7	15	41.4
11 TH	-21	55	35	+ 555	- 389.80 + 2.74	- 7	35.5	- 23.8	7	19	38.0
12 FR	-21	46	20	+ 580	- 387.06 + 2.86	- 7	59.3	- 23.2	7	23	34.5
13 SA	-21	36	40	+ 605	- 384.20 + 2.99	- 8	22.5	- 22.6	7	27	31.1
14 SU	-21	26	35	+ 630	- 381.21 + 3.11	- 8	45.1	- 21.9	7	31	27.7
15 MO	-21	16	5	+ 654	- 378.10 + 3.23	- 9	7.1	- 21.3	7	35	24.2
16 TU	-21	5	11	+ 679	- 374.87 + 3.35	- 9	28.4	- 20.6	7	39	20.8
17 WF	-20	53	52	+ 703	- 371.52 + 3.47	- 9	49.0	- 20.0	7	43	17.3
18 TH	-20	42	9	+ 726	- 368.05 + 3.59	-10	9.0	- 19.3	7	47	13.9
19 FR	-20	30	3	+ 749	- 364.46 + 3.70	-10	28.3	- 18.5	7	51	10.4
20 SA	-20	17	34	+ 773	- 360.76 + 3.82	-10	46.8	- 17.8	7	55	7.0
21 SU	-20	4	41	+ 795	- 356.54 + 3.92	-11	4.6	- 17.1	7	59	3.5
22 MO	-19	51	26	+ 817	- 353.02 + 4.04	-11	21.8	- 16.4	8	3	0.1
23 TU	-19	37	49	+ 840	- 348.98 + 4.14	-11	38.1	- 15.6	8	6	56.6
24 WF	-19	23	49	+ 860	- 344.84 + 4.25	-11	53.7	- 14.8	8	10	53.2
25 TH	-19	9	29	+ 882	- 340.59 + 4.36	-12	8.6	- 14.1	8	14	49.8
26 FR	-18	54	47	+ 903	- 336.23 + 4.46	-12	22.7	- 13.3	8	18	46.3
27 SA	-18	39	44	+ 923	- 331.77 + 4.56	-12	35.9	- 12.5	8	22	42.9
28 SU	-18	24	21	+ 943	- 327.21 + 4.65	-12	48.4	- 11.7	8	26	39.4
29 MO	-18	8	38	+ 962	- 322.56 + 4.76	-13	0.1	- 10.9	8	30	36.0
30 TU	-17	52	36	+ 982	- 317.80 + 4.84	-13	11.0	- 10.0	8	34	32.5
31 WF	-17	36	14	+1000	- 312.96 + 4.94	-13	21.1	- 9.2	8	38	29.1

Table 2. Sun, 1979, for Zero Hours Universal Time (GMT)—Continued

GREENWICH DATE	APPARENT DECLINATION					EQUATION OF TIME			SIDERAL TIME		
	DEGREES			MILS		MIN	SEC	DAILY CHANGE (SEC)	HR	MIN	SEC
	0	/	//	DAILY CHANGE (SEC)	DAILY CHANGE (MILS)						
FFR 1 TH	-17	19	34		- 308.02	-13	30.3		8	42	25.7
2 FR	-17	2	35	+1019	+ 5.03	-13	38.6	- 8.4	8	46	22.2
3 SA	-16	45	18	+1037	+ 5.12	-13	46.2	- 7.5	8	50	18.8
4 SU	-16	27	44	+1054	+ 5.21	-13	52.9	- 6.7	8	54	15.3
5 MO	-16	5	53	+1071	+ 5.29	-13	58.8	- 5.9	8	58	11.9
6 TU	-15	51	45	+1088	+ 5.37	-14	3.8	- 5.0	9	2	8.4
7 WE	-15	33	21	+1104	+ 5.45	-14	8.0	- 4.2	9	6	5.0
8 TH	-15	14	41	+1120	+ 5.53	-14	11.4	- 3.4	9	10	1.5
9 FR	-14	55	45	+1136	+ 5.61	-14	14.0	- 2.6	9	13	58.1
10 SA	-14	36	35	+1150	+ 5.68	-14	15.8	- 1.8	9	17	54.6
11 SU	-14	17	9	+1166	+ 5.76	-14	16.8	- 1.0	9	21	51.2
12 MO	-13	57	30	+1179	+ 5.82	-14	17.0	- 0.2	9	25	47.8
13 TU	-13	37	37	+1193	+ 5.89	-14	16.4	+ 0.5	9	29	44.3
14 WE	-13	17	30	+1207	+ 5.96	-14	15.1	+ 1.3	9	33	40.9
15 TH	-12	57	10	+1220	+ 6.03	-14	13.1	+ 2.0	9	37	37.4
16 FR	-12	36	38	+1232	+ 6.08	-14	10.4	+ 2.8	9	41	34.0
17 SA	-12	15	53	+1245	+ 6.15	-14	6.9	+ 3.5	9	45	30.5
18 SU	-11	54	57	+1256	+ 6.20	-14	2.7	+ 4.2	9	49	27.1
19 MO	-11	33	49	+1268	+ 6.26	-13	57.9	+ 4.8	9	53	23.6
20 TU	-11	12	31	+1278	+ 6.32	-13	52.4	+ 5.5	9	57	20.2
21 WE	-10	51	1	+1290	+ 6.37	-13	46.2	+ 6.2	10	1	16.7
22 TH	-10	29	22	+1299	+ 6.41	-13	39.4	+ 6.8	10	5	13.3
23 FR	-10	7	32	+1310	+ 6.47	-13	32.0	+ 7.4	10	9	9.8
24 SA	- 9	45	33	+1319	+ 6.51	-13	24.0	+ 8.0	10	13	6.4
25 SU	- 9	23	26	+1327	+ 6.56	-13	15.4	+ 8.6	10	17	2.9
26 MO	- 9	1	10	+1336	+ 6.60	-13	6.2	+ 9.2	10	20	59.5
27 TU	- 8	38	46	+1344	+ 6.63	-12	56.4	+ 9.8	10	24	56.0
28 WE	- 8	16	14	+1352	+ 6.68	-12	46.1	+ 10.3	10	28	52.6
				+1359	+ 6.71			+ 10.9			

Table 2. Sun, 1979, for Zero Hours Universal Time (GMT)—Continued

GREENWICH DATE		APPARENT DECLINATION					EQUATION OF TIME			SIDERAL TIME			
		DEGREES			DAILY CHANGE (SEC)	MILS		MIN	SEC	DAILY CHANGE (SEC)	HR	MIN	SEC
		0	/	//		MILS	DAILY CHANGE (MILS)						
MAR	1 TH	- 7	53	35	+1366	- 140.32	+ 6.75	-12	35.2	+ 11.4	10	32	49.1
	2 FR	- 7	30	49	+1373	- 133.57	+ 6.77	-12	23.8	+ 11.9	10	36	45.7
	3 SA	- 7	7	56	+1378	- 126.80	+ 6.81	-12	11.8	+ 12.4	10	40	42.2
	4 SU	- 6	44	58	+1384	- 119.99	+ 6.83	-11	59.4	+ 12.9	10	44	38.8
	5 MO	- 6	21	54	+1389	- 113.16	+ 6.86	-11	46.5	+ 13.4	10	48	35.4
	6 TU	- 5	58	45	+1394	- 106.30	+ 6.89	-11	33.1	+ 13.8	10	52	31.9
	7 WF	- 5	35	31	+1399	- 99.41	+ 6.90	-11	19.3	+ 14.3	10	56	28.5
	8 TH	- 5	12	12	+1402	- 92.51	+ 6.93	-11	5.0	+ 14.7	11	0	25.0
	9 FR	- 4	48	50	+1406	- 85.58	+ 6.94	-10	50.4	+ 15.1	11	4	21.6
	10 SA	- 4	25	24	+1410	- 78.64	+ 6.96	-10	35.3	+ 15.4	11	8	18.1
	11 SU	- 4	1	54	+1412	- 71.68	+ 6.98	-10	19.9	+ 15.8	11	12	14.7
	12 MO	- 3	38	22	+1415	- 64.70	+ 6.99	-10	4.1	+ 16.1	11	16	11.2
	13 TU	- 3	14	47	+1417	- 57.71	+ 7.00	- 9	48.1	+ 16.3	11	20	7.8
	14 WF	- 2	51	10	+1419	- 50.71	+ 7.00	- 9	31.7	+ 16.6	11	24	4.3
	15 TH	- 2	27	31	+1421	- 43.71	+ 7.02	- 9	15.1	+ 16.9	11	28	0.9
	16 FR	- 2	3	50	+1422	- 36.69	+ 7.02	- 8	58.2	+ 17.1	11	31	57.4
	17 SA	- 1	40	8	+1422	- 29.67	+ 7.02	- 8	41.1	+ 17.3	11	35	54.0
	18 SU	- 1	16	26	+1423	- 22.65	+ 7.03	- 8	23.8	+ 17.5	11	39	50.5
	19 MO	- 0	52	43	+1423	- 15.62	+ 7.03	- 8	6.3	+ 17.6	11	43	47.1
	20 TU	- 0	29	0	+1423	- 8.59	+ 7.02	- 7	48.7	+ 17.8	11	47	43.6
	21 WF	- 0	5	17	+1422	- 1.57	+ 7.03	- 7	30.9	+ 17.9	11	51	40.2
	22 TH	+ 0	18	25	+1421	+ 5.46	+ 7.01	- 7	13.0	+ 17.9	11	55	36.7
	23 FR	+ 0	42	6	+1420	+ 12.47	+ 7.01	- 6	55.1	+ 18.0	11	59	33.3
	24 SA	+ 1	5	46	+1418	+ 19.48	+ 7.01	- 6	37.0	+ 18.1	12	3	29.8
	25 SU	+ 1	29	24	+1416	+ 26.49	+ 6.99	- 6	19.0	+ 18.1	12	7	26.4
	26 MO	+ 1	53	0	+1413	+ 33.48	+ 6.98	- 6	0.9	+ 18.1	12	11	23.0
	27 TU	+ 2	16	33	+1411	+ 40.46	+ 6.97	- 5	42.7	+ 18.1	12	15	19.5
	28 WF	+ 2	40	4	+1407	+ 47.43	+ 6.95	- 5	24.6	+ 18.1	12	19	16.0
	29 TH	+ 3	3	31	+1404	+ 54.38	+ 6.93	- 5	6.5	+ 18.1	12	23	12.6
	30 FR	+ 3	26	55	+1400	+ 61.31	+ 6.91	- 4	48.4	+ 18.0	12	27	9.1
	31 SA	+ 3	50	15	+1395	+ 68.22	+ 6.89	- 4	30.4	+ 18.0	12	31	5.7

Table 2. Sun, 1979, for Zero Hours Universal Time (GMT)—Continued

GREENWICH DATE			APPARENT DECLINATION					EQUATION OF TIME			SIDERAL TIME			
			DEGREES			MILS		MIN	SEC	DAILY CHANGE (SEC)	HR	MIN	SEC	
			0	/	//	DAILY CHANGE (SEC)	MILS							DAILY CHANGE (MILS)
APR	1	SU	+ 4	13	30	+1391	+ 75.11	+ 6.87	- 4	12.4	+ 17.9	12	35	2.2
	2	MO	+ 4	36	41	+1386	+ 81.98	+ 6.84	- 3	54.5	+ 17.8	12	38	58.8
	3	TU	+ 4	59	47	+1380	+ 88.82	+ 6.82	- 3	36.7	+ 17.7	12	42	55.4
	4	WE	+ 5	22	47	+1375	+ 95.64	+ 6.79	- 3	19.0	+ 17.6	12	46	51.9
	5	TH	+ 5	45	42	+1369	+ 102.43	+ 6.76	- 3	1.4	+ 17.4	12	50	48.5
	6	FR	+ 6	8	31	+1362	+ 109.19	+ 6.72	- 2	44.0	+ 17.2	12	54	45.0
	7	SA	+ 6	31	13	+1355	+ 115.91	+ 6.70	- 2	26.8	+ 17.0	12	58	41.6
	8	SU	+ 6	53	48	+1348	+ 122.61	+ 6.66	- 2	9.7	+ 16.8	13	2	38.1
	9	MO	+ 7	16	16	+1341	+ 129.27	+ 6.62	- 1	52.9	+ 16.6	13	6	34.7
	10	TU	+ 7	38	27	+1333	+ 135.89	+ 6.58	- 1	36.3	+ 16.4	13	10	31.2
	11	WE	+ 8	0	50	+1325	+ 142.47	+ 6.54	- 1	19.9	+ 16.1	13	14	27.8
	12	TH	+ 8	22	55	+1316	+ 149.01	+ 6.50	- 1	3.8	+ 15.8	13	18	24.3
	13	FR	+ 8	44	51	+1308	+ 155.51	+ 6.46	- 0	48.0	+ 15.5	13	22	20.9
	14	SA	+ 9	6	39	+1298	+ 161.97	+ 6.41	- 0	32.5	+ 15.2	13	26	17.4
	15	SU	+ 9	28	17	+1290	+ 168.38	+ 6.37	- 0	17.4	+ 14.8	13	30	14.0
	16	MO	+ 9	49	47	+1279	+ 174.75	+ 6.32	- 0	2.5	+ 14.4	13	34	10.5
	17	TU	+10	11	6	+1270	+ 181.07	+ 6.27	+ 0	11.5	+ 14.1	13	38	7.1
	18	WE	+10	32	16	+1259	+ 187.34	+ 6.22	+ 0	26.0	+ 13.7	13	42	3.6
	19	TH	+10	53	15	+1248	+ 193.56	+ 6.16	+ 0	39.6	+ 13.2	13	46	0.2
	20	FR	+11	14	3	+1238	+ 199.72	+ 6.11	+ 0	52.9	+ 12.8	13	49	56.8
	21	SA	+11	34	41	+1226	+ 205.83	+ 6.06	+ 1	5.7	+ 12.4	13	53	53.3
	22	SU	+11	55	7	+1214	+ 211.89	+ 5.99	+ 1	18.0	+ 11.9	13	57	49.9
	23	MO	+12	15	21	+1203	+ 217.88	+ 5.94	+ 1	29.9	+ 11.4	14	1	46.4
	24	TU	+12	35	24	+1190	+ 223.82	+ 5.88	+ 1	41.4	+ 11.0	14	5	43.0
	25	WE	+12	55	14	+1177	+ 229.70	+ 5.81	+ 1	52.3	+ 10.5	14	9	39.5
	26	TH	+13	14	51	+1164	+ 235.51	+ 5.75	+ 2	2.8	+ 10.0	14	13	36.1
	27	FR	+13	34	15	+1151	+ 241.26	+ 5.68	+ 2	12.8	+ 9.5	14	17	32.6
	28	SA	+13	53	26	+1138	+ 246.94	+ 5.62	+ 2	22.3	+ 9.0	14	21	29.2
	29	SU	+14	12	24	+1123	+ 252.56	+ 5.55	+ 2	31.3	+ 8.5	14	25	25.7
	30	MO	+14	31	7	+1108	+ 258.11	+ 5.47	+ 2	39.8	+ 8.0	14	29	22.3

Table 2. Sun, 1979, for Zero Hours Universal Time (GMT)—Continued

GREENWICH DATE		APPARENT DECLINATION					EQUATION OF TIME			SIDERAL TIME			
		DEGREES			DAILY CHANGE (SEC)	MILS		MIN	SEC	DAILY CHANGE (SEC)	HR	MIN	SEC
		0	/	//		MILS	DAILY CHANGE (MILS)						
MAY	1 TU	+14	49	35	+1094	+ 263.58	+ 5.40	+ 2	47.8	+ 7.5	14	33	18.8
	2 WF	+15	7	49	+1079	+ 268.98	+ 5.33	+ 2	55.3	+ 6.9	14	37	15.4
	3 TH	+15	25	48	+1064	+ 274.31	+ 5.25	+ 3	2.2	+ 6.4	14	41	12.0
	4 FR	+15	43	32	+1048	+ 279.56	+ 5.18	+ 3	8.6	+ 5.9	14	45	8.5
	5 SA	+16	1	0	+1032	+ 284.74	+ 5.09	+ 3	14.5	+ 5.3	14	49	5.1
	6 SU	+16	18	12	+1015	+ 289.83	+ 5.02	+ 3	19.9	+ 4.8	14	53	1.6
	7 MO	+16	35	7	+ 999	+ 294.85	+ 4.93	+ 3	24.7	+ 4.3	14	56	58.2
	8 TU	+16	51	46	+ 982	+ 299.78	+ 4.85	+ 3	29.0	+ 3.7	15	0	54.7
	9 WF	+17	8	8	+ 965	+ 304.63	+ 4.77	+ 3	32.7	+ 3.2	15	4	51.3
	10 TH	+17	24	13	+ 947	+ 309.40	+ 4.68	+ 3	35.8	+ 2.6	15	8	47.8
	11 FR	+17	40	0	+ 930	+ 314.08	+ 4.59	+ 3	38.4	+ 2.0	15	12	44.4
	12 SA	+17	55	30	+ 911	+ 318.67	+ 4.50	+ 3	40.4	+ 1.4	15	16	40.9
	13 SU	+18	10	41	+ 893	+ 323.17	+ 4.41	+ 3	41.9	+ 0.9	15	20	37.5
	14 MO	+18	25	34	+ 875	+ 327.58	+ 4.32	+ 3	42.7	+ 0.3	15	24	34.0
	15 TU	+18	40	9	+ 856	+ 331.90	+ 4.22	+ 3	43.0	- 0.3	15	28	30.6
	16 WF	+18	54	25	+ 836	+ 336.12	+ 4.13	+ 3	42.7	- 0.9	15	32	27.2
	17 TH	+19	8	21	+ 818	+ 340.25	+ 4.04	+ 3	41.8	- 1.5	15	36	23.7
	18 FR	+19	21	59	+ 797	+ 344.29	+ 3.94	+ 3	40.4	- 2.0	15	40	20.3
	19 SA	+19	35	16	+ 778	+ 348.23	+ 3.84	+ 3	38.3	- 2.6	15	44	16.8
	20 SU	+19	48	14	+ 757	+ 352.07	+ 3.74	+ 3	35.7	- 3.2	15	48	13.4
	21 MO	+20	0	51	+ 737	+ 355.81	+ 3.64	+ 3	32.5	- 3.7	15	52	9.9
	22 TU	+20	13	8	+ 716	+ 359.45	+ 3.53	+ 3	28.8	- 4.3	15	56	6.5
	23 WF	+20	25	4	+ 696	+ 362.98	+ 3.44	+ 3	24.5	- 4.8	16	0	3.0
	24 TH	+20	36	40	+ 674	+ 366.42	+ 3.33	+ 3	19.7	- 5.3	16	3	59.6
	25 FR	+20	47	54	+ 653	+ 369.75	+ 3.22	+ 3	14.3	- 5.9	16	7	56.1
	26 SA	+20	58	47	+ 631	+ 372.97	+ 3.12	+ 3	8.5	- 6.3	16	11	52.7
	27 SU	+21	9	18	+ 609	+ 376.09	+ 3.01	+ 3	2.1	- 6.8	16	15	49.3
	28 MO	+21	19	27	+ 587	+ 379.10	+ 2.89	+ 2	55.3	- 7.3	16	19	45.8
	29 TU	+21	29	14	+ 565	+ 381.99	+ 2.79	+ 2	48.0	- 7.7	16	23	42.4
	30 WF	+21	38	39	+ 542	+ 384.78	+ 2.68	+ 2	40.3	- 8.2	16	27	38.9
	31 TH	+21	47	41	+ 519	+ 387.46	+ 2.57	+ 2	32.1	- 8.6	16	31	35.5

Table 2. Sun, 1979, for Zero Hours Universal Time (GMT)—Continued

GREENWICH DATE		APPARENT DECLINATION					EQUATION OF TIME			SIDERAL TIME			
		DEGREES			DAILY CHANGE (SEC)	MILS		MIN	SEC	DAILY CHANGE (SEC)	HR	MIN	SEC
		0	/	//		MILS	DAILY CHANGE (MILS)						
JUN	1 FR	+21	56	20	+ 497	+ 390.03	+ 2.45	+ 2	23.5	- 9.0	16	35	32.1
	2 SA	+22	4	37	+ 473	+ 392.48	+ 2.34	+ 2	14.5	- 9.3	16	39	28.6
	3 SU	+22	12	30	+ 450	+ 394.82	+ 2.22	+ 2	5.2	- 9.7	16	43	25.2
	4 MO	+22	20	0	+ 427	+ 397.04	+ 2.11	+ 1	55.5	- 10.0	16	47	21.7
	5 TU	+22	27	7	+ 403	+ 399.15	+ 1.99	+ 1	45.4	- 10.4	16	51	18.3
	6 WF	+22	33	50	+ 379	+ 401.14	+ 1.87	+ 1	35.1	- 10.7	16	55	14.8
	7 TH	+22	40	9	+ 356	+ 403.01	+ 1.75	+ 1	24.4	- 11.0	16	59	11.4
	8 FR	+22	46	5	+ 331	+ 404.76	+ 1.64	+ 1	13.4	- 11.2	17	3	7.9
	9 SA	+22	51	36	+ 307	+ 406.40	+ 1.52	+ 1	2.2	- 11.5	17	7	4.5
	10 SU	+22	56	43	+ 284	+ 407.92	+ 1.40	+ 0	50.7	- 11.7	17	11	1.0
	11 MO	+23	1	27	+ 258	+ 409.32	+ 1.27	+ 0	38.9	- 12.0	17	14	57.6
	12 TU	+23	5	45	+ 235	+ 410.59	+ 1.16	+ 0	27.0	- 12.2	17	18	54.2
	13 WF	+23	9	40	+ 210	+ 411.75	+ 1.04	+ 0	14.8	- 12.4	17	22	50.7
	14 TH	+23	13	10	+ 185	+ 412.79	+ 0.91	+ 0	2.4	- 12.5	17	26	47.3
	15 FR	+23	16	15	+ 161	+ 413.70	+ 0.80	- 0	10.1	- 12.7	17	30	43.8
	16 SA	+23	18	56	+ 136	+ 414.50	+ 0.67	- 0	22.8	- 12.8	17	34	40.4
	17 SU	+23	21	12	+ 111	+ 415.17	+ 0.55	- 0	35.6	- 12.9	17	38	37.0
	18 MO	+23	23	3	+ 87	+ 415.72	+ 0.43	- 0	48.6	- 13.0	17	42	33.5
	19 TU	+23	24	30	+ 62	+ 416.15	+ 0.30	- 1	1.6	- 13.1	17	46	30.1
	20 WF	+23	25	32	+ 37	+ 416.45	+ 0.19	- 1	14.7	- 13.1	17	50	26.6
	21 TH	+23	26	9	+ 12	+ 416.64	+ 0.06	- 1	27.8	- 13.1	17	54	23.2
	22 FR	+23	26	21	- 13	+ 416.70	+ 0.07	- 1	40.9	- 13.1	17	58	19.7
	23 SA	+23	26	8	- 37	+ 416.63	+ 0.18	- 1	54.0	- 13.1	18	2	16.3
	24 SU	+23	25	31	- 62	+ 416.45	+ 0.31	- 2	7.1	- 13.0	18	6	12.8
	25 MO	+23	24	29	- 87	+ 416.14	+ 0.42	- 2	20.1	- 12.9	18	10	9.4
	26 TU	+23	23	2	- 111	+ 415.72	+ 0.56	- 2	32.9	- 12.7	18	14	6.0
	27 WF	+23	21	11	- 136	+ 415.16	+ 0.67	- 2	45.7	- 12.6	18	18	2.5
	28 TH	+23	18	55	- 161	+ 414.49	+ 0.79	- 2	58.3	- 12.4	18	21	59.1
	29 FR	+23	16	14	- 185	+ 413.70	+ 0.91	- 3	10.7	- 12.2	18	25	55.6
	30 SA	+23	13	9	- 209	+ 412.79	+ 1.04	- 3	22.9	- 12.0	18	29	52.2

Table 2. Sun, 1979, for Zero Hours Universal Time (GMT)—Continued

GREENWICH DATE		APPARENT DECLINATION					EQUATION OF TIME			SIDERAL TIME			
		DEGREES			DAILY CHANGE (SEC)	MILS		MIN	SEC	DAILY CHANGE (SEC)	HR	MIN	SEC
		0	/	//		MILS	DAILY CHANGE (MILS)						
JUL	1 SU	+23	9	40	- 234	+ 411.75	+ 1.15	- 3	34.8	- 11.7	18	33	48.8
	2 MO	+23	5	46	- 258	+ 410.60	+ 1.28	- 3	46.5	- 11.4	18	37	45.3
	3 TU	+23	1	28	- 282	+ 409.32	+ 1.39	- 3	58.0	- 11.1	18	41	41.9
	4 WE	+22	56	46	- 306	+ 407.93	+ 1.51	- 4	9.1	- 10.8	18	45	38.4
	5 TH	+22	51	40	- 330	+ 406.42	+ 1.63	- 4	19.9	- 10.5	18	49	35.0
	6 FR	+22	46	10	- 354	+ 404.79	+ 1.75	- 4	30.4	- 10.1	18	53	31.5
	7 SA	+22	40	16	- 377	+ 403.04	+ 1.86	- 4	40.5	- 9.7	18	57	28.1
	8 SU	+22	33	59	- 401	+ 401.18	+ 1.98	- 4	50.2	- 9.3	19	1	24.6
	9 MO	+22	27	18	- 424	+ 399.20	+ 2.09	- 4	59.6	- 8.9	19	5	21.2
	10 TU	+22	20	14	- 447	+ 397.11	+ 2.21	- 5	8.5	- 8.5	19	9	17.8
	11 WE	+22	12	47	- 470	+ 394.90	+ 2.32	- 5	17.1	- 8.1	19	13	14.3
	12 TH	+22	4	57	- 493	+ 392.58	+ 2.44	- 5	25.2	- 7.7	19	17	10.9
	13 FR	+21	56	44	- 516	+ 390.14	+ 2.54	- 5	32.8	- 7.2	19	21	7.4
	14 SA	+21	48	8	- 537	+ 387.60	+ 2.66	- 5	40.1	- 6.8	19	25	4.0
	15 SU	+21	39	11	- 561	+ 384.94	+ 2.77	- 5	46.8	- 6.3	19	29	0.5
	16 MO	+21	29	50	- 582	+ 382.17	+ 2.87	- 5	53.1	- 5.8	19	32	57.1
	17 TU	+21	20	8	- 603	+ 379.30	+ 2.98	- 5	58.9	- 5.3	19	36	53.6
	18 WE	+21	10	5	- 626	+ 376.32	+ 3.09	- 6	4.3	- 4.8	19	40	50.2
	19 TH	+20	59	39	- 646	+ 373.23	+ 3.19	- 6	9.0	- 4.3	19	44	46.8
	20 FR	+20	48	53	- 668	+ 370.04	+ 3.30	- 6	13.3	- 3.8	19	48	43.3
	21 SA	+20	37	45	- 689	+ 366.74	+ 3.40	- 6	17.1	- 3.2	19	52	39.9
	22 SU	+20	26	16	- 709	+ 363.34	+ 3.50	- 6	20.3	- 2.6	19	56	36.4
	23 MO	+20	14	27	- 729	+ 359.84	+ 3.60	- 6	22.9	- 2.1	20	0	33.0
	24 TU	+20	2	18	- 750	+ 356.24	+ 3.71	- 6	25.0	- 1.5	20	4	29.6
	25 WE	+19	49	48	- 769	+ 352.53	+ 3.79	- 6	26.5	- 0.9	20	8	26.1
	26 TH	+19	36	59	- 789	+ 348.74	+ 3.90	- 6	27.4	- 0.3	20	12	22.7
	27 FR	+19	23	50	- 808	+ 344.84	+ 3.99	- 6	27.7	+ 0.3	20	16	19.2
	28 SA	+19	10	22	- 827	+ 340.85	+ 4.08	- 6	27.4	+ 0.9	20	20	15.8
	29 SU	+18	56	35	- 845	+ 336.77	+ 4.18	- 6	26.5	+ 1.5	20	24	12.3
	30 MO	+18	42	30	- 864	+ 332.59	+ 4.27	- 6	25.0	+ 2.2	20	28	8.9
	31 TU	+18	28	6	- 883	+ 328.32	+ 4.35	- 6	22.8	+ 2.8	20	32	5.4

Table 2. Sun, 1979, for Zero Hours Universal Time (GMT)—Continued

GREENWICH DATE	APPARENT DECLINATION					EQUATION OF TIME			SIDERAL TIME		
	DEGREES			MILS		MIN	SEC	DAILY CHANGE (SEC)	HR	MIN	SEC
	0	/	//	DAILY CHANGE (SEC)	MILS DAILY CHANGE (MILS)						
AUG 1 WF	+18	13	23	- 900	+ 323.97 + 4.45	- 6	20.0	+ 3.4	20	36	2.0
2 TH	+17	58	23	- 917	+ 319.52 + 4.53	- 6	16.6	+ 4.0	20	39	58.5
3 FR	+17	43	6	- 935	+ 314.99 + 4.62	- 6	12.6	+ 4.7	20	43	55.1
4 SA	+17	27	31	- 952	+ 310.37 + 4.70	- 6	7.9	+ 5.3	20	47	51.6
5 SU	+17	11	39	- 969	+ 305.67 + 4.78	- 6	2.6	+ 5.9	20	51	48.2
6 MO	+16	55	30	- 985	+ 300.89 + 4.86	- 5	56.8	+ 6.5	20	55	44.8
7 TU	+16	39	5	-1001	+ 296.03 + 4.95	- 5	50.3	+ 7.1	20	59	41.3
8 WF	+16	22	24	-1016	+ 291.08 + 5.02	- 5	43.1	+ 7.7	21	3	37.9
9 TH	+16	5	28	-1033	+ 286.06 + 5.10	- 5	35.5	+ 8.3	21	7	34.4
10 FR	+15	48	15	-1047	+ 280.56 + 5.17	- 5	27.2	+ 8.8	21	11	31.0
11 SA	+15	30	48	-1063	+ 275.79 + 5.24	- 5	18.3	+ 9.4	21	15	27.5
12 SU	+15	13	5	-1077	+ 270.55 + 5.32	- 5	8.9	+ 9.9	21	19	24.1
13 MO	+14	55	8	-1091	+ 265.23 + 5.39	- 4	59.0	+ 10.5	21	23	20.6
14 TU	+14	36	57	-1106	+ 259.84 + 5.46	- 4	48.5	+ 11.0	21	27	17.2
15 WE	+14	18	31	-1119	+ 254.38 + 5.53	- 4	37.5	+ 11.5	21	31	13.7
16 TH	+13	59	52	-1132	+ 248.85 + 5.59	- 4	26.0	+ 12.0	21	35	10.3
17 FR	+13	41	0	-1146	+ 243.26 + 5.66	- 4	13.9	+ 12.5	21	39	6.8
18 SA	+13	21	54	-1159	+ 237.60 + 5.72	- 4	1.4	+ 13.0	21	43	3.4
19 SU	+13	2	35	-1171	+ 231.88 + 5.78	- 3	48.3	+ 13.5	21	47	0.0
20 MO	+12	43	4	-1183	+ 226.10 + 5.85	- 3	34.8	+ 14.0	21	50	56.5
21 TU	+12	23	21	-1194	+ 220.25 + 5.90	- 3	20.8	+ 14.5	21	54	53.1
22 WE	+12	3	27	-1207	+ 214.35 + 5.95	- 3	6.3	+ 14.9	21	58	49.6
23 TH	+11	43	20	-1217	+ 208.40 + 6.01	- 2	51.4	+ 15.4	22	2	46.2
24 FR	+11	23	3	-1228	+ 202.39 + 6.07	- 2	36.0	+ 15.8	22	6	42.7
25 SA	+11	2	35	-1239	+ 196.32 + 6.12	- 2	20.2	+ 16.3	22	10	39.3
26 SU	+10	41	56	-1249	+ 190.20 + 6.16	- 2	3.5	+ 16.7	22	14	35.8
27 MO	+10	21	7	-1258	+ 184.04 + 6.22	- 1	47.3	+ 17.1	22	18	32.4
28 TU	+10	0	9	-1268	+ 177.82 + 6.26	- 1	30.2	+ 17.5	22	22	28.9
29 WE	+ 9	39	1	-1278	+ 171.56 + 6.31	- 1	12.8	+ 17.8	22	26	25.5
30 TH	+ 9	17	43	-1286	+ 165.25 + 6.35	- 0	54.9	+ 18.2	22	30	22.0
31 FR	+ 8	56	17	-1294	+ 158.90 + 6.39	- 0	36.7	+ 18.5	22	34	18.6

Table 2. Sun, 1979, for Zero Hours Universal Time (GMT)—Continued

GREENWICH DATE	APPARENT DECLINATION						EQUATION OF TIME			SIDERAL TIME		
	DEGREES			DAILY CHANGE (SEC)	MILS		MIN	SEC	DAILY CHANGE (SEC)	HR	MIN	SEC
	0	/	//		MILS	DAILY CHANGE (MILS)						
SFP	1	SA	+ 8 34 43	-1303	+ 152.51	+ 6.44	- 0	18.2	+ 18.9	22	38	15.1
	2	SU	+ 8 13 0	-1310	+ 146.07	+ 6.47	+ 0	0.7	+ 19.2	22	42	11.7
	3	MO	+ 7 51 10	-1318	+ 139.60	+ 6.51	+ 0	19.9	+ 19.5	22	46	8.3
	4	TU	+ 7 29 12	-1326	+ 133.09	+ 6.54	+ 0	39.4	+ 15.8	22	50	4.8
	5	WE	+ 7 7 6	-1332	+ 126.55	+ 6.58	+ 0	59.1	+ 20.0	22	54	1.4
	6	TH	+ 6 44 54	-1339	+ 119.97	+ 6.61	+ 1	19.1	+ 20.2	22	57	57.9
	7	FR	+ 6 22 35	-1345	+ 113.36	+ 6.64	+ 1	39.4	+ 20.4	23	1	54.5
	8	SA	+ 6 0 10	-1351	+ 106.72	+ 6.68	+ 1	59.8	+ 20.6	23	5	51.0
	9	SU	+ 5 37 39	-1357	+ 100.04	+ 6.70	+ 2	20.4	+ 20.8	23	9	47.6
	10	MO	+ 5 15 2	-1362	+ 93.34	+ 6.72	+ 2	41.2	+ 20.9	23	13	44.1
	11	TU	+ 4 52 20	-1367	+ 86.62	+ 6.75	+ 3	2.1	+ 21.0	23	17	40.7
	12	WE	+ 4 29 33	-1372	+ 79.87	+ 6.78	+ 3	23.1	+ 21.1	23	21	37.2
	13	TH	+ 4 6 41	-1377	+ 73.09	+ 6.80	+ 3	44.2	+ 21.2	23	25	33.8
	14	FR	+ 3 43 44	-1380	+ 66.29	+ 6.82	+ 4	5.4	+ 21.2	23	29	30.3
	15	SA	+ 3 20 44	-1385	+ 59.47	+ 6.83	+ 4	26.6	+ 21.3	23	33	26.9
	16	SU	+ 2 57 39	-1388	+ 52.64	+ 6.85	+ 4	47.9	+ 21.3	23	37	23.4
	17	MO	+ 2 34 31	-1390	+ 45.79	+ 6.87	+ 5	9.2	+ 21.3	23	41	20.0
	18	TU	+ 2 11 21	-1394	+ 38.92	+ 6.88	+ 5	30.5	+ 21.3	23	45	16.5
	19	WE	+ 1 48 7	-1396	+ 32.04	+ 6.90	+ 5	51.8	+ 21.3	23	49	13.1
	20	TH	+ 1 24 51	-1398	+ 25.14	+ 6.90	+ 6	13.1	+ 21.2	23	53	9.6
	21	FR	+ 1 1 33	-1400	+ 18.24	+ 6.91	+ 6	34.3	+ 21.1	23	57	6.2
	22	SA	+ 0 38 13	-1401	+ 11.33	+ 6.92	+ 6	55.4	+ 21.0	0	1	2.7
	23	SU	+ 0 14 52	-1402	+ 4.41	+ 6.93	+ 7	16.5	+ 20.9	0	4	59.3
	24	MO	- 0 8 30	-1402	- 2.52	+ 6.92	+ 7	37.4	+ 20.8	0	8	55.8
	25	TU	- 0 31 52	-1403	- 9.44	+ 6.93	+ 7	58.3	+ 20.7	0	12	52.4
	26	WE	- 0 55 15	-1403	- 16.37	+ 6.93	+ 8	19.0	+ 20.5	0	16	48.9
	27	TH	- 1 18 38	-1402	- 23.30	+ 6.92	+ 8	39.5	+ 20.4	0	20	45.5
	28	FR	- 1 42 0	-1402	- 30.22	+ 6.93	+ 8	59.9	+ 20.2	0	24	42.0
	29	SA	- 2 5 22	-1400	- 37.15	+ 6.91	+ 9	20.0	+ 19.9	0	28	38.6
	30	SU	- 2 28 42	-1399	- 44.06	+ 6.91	+ 9	40.0	+ 19.7	0	32	35.2

Table 2. Sun, 1979, for Zero Hours Universal Time (GMT)—Continued

GREENWICH DATE		APPARENT DECLINATION					EQUATION OF TIME			SIDERAL TIME			
		DEGREES			DAILY CHANGE (SEC)	MILS		MIN	SEC	DAILY CHANGE (SEC)	HR	MIN	SEC
		0	/	//		MILS	DAILY CHANGE (MILS)						
OCT	1 MON	- 2	52	1	-1397	- 50.97	+ 6.90	+ 9	59.7	+ 19.5	0	36	31.7
	2 TU	- 3	15	18	-1395	- 57.87	+ 6.89	+10	19.2	+ 19.2	0	40	28.3
	3 WE	- 3	38	33	-1393	- 64.76	+ 6.87	+10	38.4	+ 18.9	0	44	24.8
	4 TH	- 4	1	46	-1389	- 71.63	+ 6.86	+10	57.3	+ 18.6	0	48	21.4
	5 FR	- 4	24	55	-1386	- 78.49	+ 6.85	+11	15.9	+ 18.2	0	52	17.9
	6 SA	- 4	48	1	-1383	- 85.34	+ 6.83	+11	34.1	+ 17.9	0	56	14.5
	7 SU	- 5	11	4	-1378	- 92.17	+ 6.80	+11	52.0	+ 17.5	1	0	11.0
	8 MO	- 5	34	2	-1375	- 98.97	+ 6.79	+12	9.5	+ 17.0	1	4	7.6
	9 TU	- 5	56	57	-1370	- 105.76	+ 6.77	+12	26.5	+ 16.6	1	8	4.1
	10 WE	- 6	19	47	-1365	- 112.53	+ 6.74	+12	43.1	+ 16.1	1	12	0.7
	11 TH	- 6	42	32	-1359	- 119.27	+ 6.71	+12	59.2	+ 15.6	1	15	57.2
	12 FR	- 7	5	11	-1354	- 125.98	+ 6.69	+13	14.5	+ 15.1	1	19	53.8
	13 SA	- 7	27	45	-1348	- 132.67	+ 6.66	+13	30.0	+ 14.6	1	23	50.3
	14 SU	- 7	50	13	-1342	- 139.33	+ 6.62	+13	44.6	+ 14.1	1	27	46.9
	15 MON	- 8	12	35	-1335	- 145.95	+ 6.59	+13	58.7	+ 13.5	1	31	43.4
	16 TU	- 8	34	50	-1327	- 152.54	+ 6.56	+14	12.2	+ 12.9	1	35	40.0
	17 WE	- 8	56	57	-1320	- 159.10	+ 6.51	+14	25.1	+ 12.3	1	39	36.5
	18 TH	- 9	18	57	-1312	- 165.61	+ 6.48	+14	37.5	+ 11.7	1	43	33.1
	19 FR	- 9	40	49	-1303	- 172.09	+ 6.44	+14	49.2	+ 11.1	1	47	29.6
	20 SA	-10	2	32	-1295	- 178.53	+ 6.39	+15	0.3	+ 10.5	1	51	26.2
	21 SU	-10	24	7	-1286	- 184.92	+ 6.35	+15	10.8	+ 9.8	1	55	22.7
	22 MON	-10	45	33	-1276	- 191.27	+ 6.30	+15	20.6	+ 9.2	1	59	19.3
	23 TU	-11	6	49	-1266	- 197.57	+ 6.26	+15	29.8	+ 8.5	2	3	15.8
	24 WE	-11	27	55	-1255	- 203.83	+ 6.20	+15	38.3	+ 7.8	2	7	12.4
	25 TH	-11	48	50	-1245	- 210.03	+ 6.14	+15	46.1	+ 7.1	2	11	9.0
	26 FR	-12	9	35	-1234	- 216.17	+ 6.09	+15	53.3	+ 6.4	2	15	5.5
	27 SA	-12	30	9	-1221	- 222.26	+ 6.04	+15	59.7	+ 5.7	2	19	2.1
	28 SU	-12	50	30	-1210	- 228.30	+ 5.97	+16	5.4	+ 5.0	2	22	58.6
	29 MON	-13	10	40	-1198	- 234.27	+ 5.92	+16	10.4	+ 4.3	2	26	55.2
	30 TU	-13	30	38	-1184	- 240.19	+ 5.84	+16	14.7	+ 3.5	2	30	51.7
	31 WE	-13	50	22	-1171	- 246.03	+ 5.79	+16	18.2	+ 2.8	2	34	48.3

Table 2. Sun, 1979, for Zero Hours Universal Time (GMT)—Continued

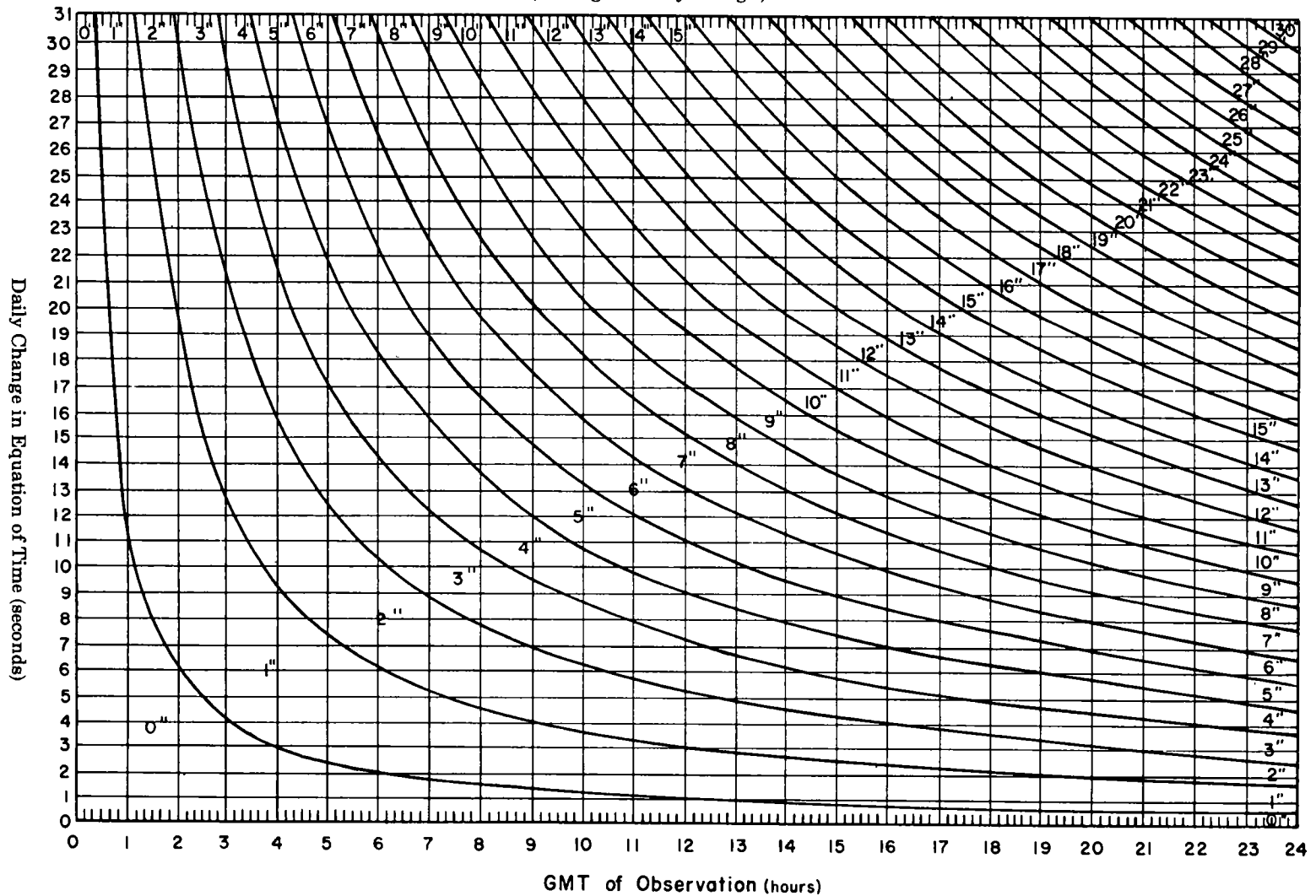
GREENWICH DATE	APPARENT DECLINATION					EQUATION OF TIME			SIDERAL TIME		
	DEGREES			MILS		MIN	SEC	DAILY CHANGE (SEC)	HR	MIN	SEC
	0	/	//	DAILY CHANGE (SEC)	MILS						
NOV 1 TH	-14	9	53	-1158	- 251.82	+16	20.9	+ 2.0	2	38	44.8
2 FR	-14	29	11	-1143	- 257.53	+16	22.9	+ 1.2	2	42	41.4
3 SA	-14	48	14	-1129	- 263.18	+16	24.1	+ 0.4	2	46	37.9
4 SU	-15	7	3	-1114	- 268.76	+16	24.4	- 0.4	2	50	34.5
5 MO	-15	25	37	-1099	- 274.26	+16	24.0	- 1.3	2	54	31.0
6 TU	-15	43	56	-1083	- 279.68	+16	22.7	- 2.1	2	58	27.6
7 WE	-16	1	59	-1068	- 285.03	+16	20.6	- 2.9	3	2	24.2
8 TH	-16	19	47	-1051	- 290.31	+16	17.7	- 3.8	3	6	20.7
9 FR	-16	37	18	-1034	- 295.50	+16	13.9	- 4.7	3	10	17.3
10 SA	-16	54	32	-1017	- 300.60	+16	9.2	- 5.5	3	14	13.8
11 SU	-17	11	29	- 999	- 305.62	+16	3.7	- 6.4	3	18	10.4
12 MO	-17	28	8	- 982	- 310.56	+15	57.3	- 7.3	3	22	6.9
13 TU	-17	44	30	- 963	- 315.41	+15	50.0	- 8.1	3	26	3.5
14 WE	-18	0	33	- 944	- 320.16	+15	41.9	- 9.0	3	30	0.1
15 TH	-18	16	17	- 925	- 324.83	+15	32.9	- 9.9	3	33	56.6
16 FR	-18	31	42	- 906	- 329.39	+15	23.0	- 10.7	3	37	53.2
17 SA	-18	46	48	- 886	- 333.87	+15	12.3	- 11.6	3	41	49.7
18 SU	-19	1	34	- 865	- 338.24	+15	0.7	- 12.4	3	45	46.3
19 MO	-19	15	59	- 844	- 342.51	+14	48.3	- 13.2	3	49	42.8
20 TU	-19	30	3	- 824	- 346.68	+14	35.1	- 14.1	3	53	39.4
21 WE	-19	43	47	- 802	- 350.75	+14	21.0	- 14.8	3	57	35.9
22 TH	-19	57	9	- 780	- 354.71	+14	6.2	- 15.6	4	1	32.5
23 FR	-20	10	9	- 758	- 358.56	+13	50.5	- 16.4	4	5	29.0
24 SA	-20	22	47	- 735	- 362.30	+13	34.1	- 17.2	4	9	25.6
25 SU	-20	35	2	- 712	- 365.94	+13	16.9	- 17.9	4	13	22.2
26 MO	-20	46	54	- 689	- 369.45	+12	59.0	- 18.7	4	17	18.7
27 TU	-20	58	23	- 666	- 372.85	+12	40.3	- 19.4	4	21	15.3
28 WE	-21	9	29	- 641	- 376.14	+12	20.9	- 20.1	4	25	11.8
29 TH	-21	20	10	- 617	- 379.31	+12	0.9	- 20.8	4	29	8.4
30 FR	-21	30	27	- 593	- 382.36	+11	40.1	- 21.4	4	33	4.9

Table 2. Sun, 1979, for Zero Hours Universal Time (GMT)—Continued

GREENWICH DATE		APPARENT DECLINATION				EQUATION OF TIME			SIDERAL TIME			
		DEGREES 0 / //		DAILY CHANGE (SEC)	MILS		MIN	SEC	DAILY CHANGE (SEC)	HR	MIN	SEC
					MILS	DAILY CHANGE (MILS)						
DEC	1 SA	-21 40 20	- 567	- 385.28	+ 2.81	+11	18.7	- 22.1	4	37	1.5	
	2 SU	-21 49 47	- 543	- 388.09	+ 2.67	+10	56.6	- 22.7	4	40	58.0	
	3 MO	-21 58 50	- 517	- 390.76	+ 2.56	+10	33.9	- 23.3	4	44	54.6	
	4 TU	-22 7 27	- 492	- 393.32	+ 2.43	+10	10.6	- 23.9	4	48	51.2	
	5 WF	-22 15 39	- 466	- 395.75	+ 2.30	+ 9	46.6	- 24.5	4	52	47.7	
	6 TH	-22 23 25	- 439	- 398.05	+ 2.17	+ 9	22.2	- 25.1	4	56	44.3	
	7 FR	-22 30 44	- 413	- 400.22	+ 2.04	+ 8	57.1	- 25.6	5	0	40.8	
	8 SA	-22 37 37	- 387	- 402.26	+ 1.91	+ 8	31.5	- 26.1	5	4	37.4	
	9 SU	-22 44 4	- 360	- 404.17	+ 1.78	+ 8	5.4	- 26.6	5	8	34.0	
	10 MO	-22 50 4	- 333	- 405.95	+ 1.64	+ 7	38.8	- 27.0	5	12	30.5	
	11 TU	-22 55 37	- 306	- 407.59	+ 1.51	+ 7	11.8	- 27.5	5	16	27.1	
	12 WF	-23 0 43	- 279	- 409.10	+ 1.38	+ 6	44.3	- 27.9	5	20	23.6	
	13 TH	-23 5 22	- 251	- 410.48	+ 1.24	+ 6	16.4	- 28.2	5	24	20.2	
	14 FR	-23 9 33	- 223	- 411.72	+ 1.10	+ 5	48.2	- 28.6	5	28	16.7	
	15 SA	-23 13 16	- 196	- 412.82	+ 0.97	+ 5	19.6	- 28.9	5	32	13.3	
	16 SU	-23 16 32	- 168	- 413.79	+ 0.83	+ 4	50.8	- 29.1	5	36	9.8	
	17 MO	-23 19 20	- 140	- 414.62	+ 0.69	+ 4	21.6	- 29.4	5	40	6.4	
	18 TU	-23 21 40	- 112	- 415.31	+ 0.55	+ 3	52.3	- 29.6	5	44	3.0	
	19 WF	-23 23 32	- 84	- 415.86	+ 0.41	+ 3	22.7	- 29.7	5	47	59.5	
	20 TH	-23 24 56	- 55	- 416.27	+ 0.28	+ 2	53.0	- 29.8	5	51	56.1	
	21 FR	-23 25 51	- 28	- 416.55	+ 0.13	+ 2	23.1	- 29.9	5	55	52.6	
	22 SA	-23 26 19	+ 1	- 416.68	+ 0.0	+ 1	53.2	- 29.9	5	59	49.2	
	23 SU	-23 26 18	+ 29	- 416.68	+ 0.14	+ 1	23.3	- 29.9	6	3	45.8	
	24 MO	-23 25 49	+ 58	- 416.54	+ 0.29	+ 0	53.3	- 29.9	6	7	42.3	
	25 TU	-23 24 51	+ 85	- 416.25	+ 0.42	+ 0	23.4	- 29.8	6	11	38.9	
	26 WF	-23 23 26	+ 114	- 415.83	+ 0.56	- 0	6.4	- 29.7	6	15	35.4	
	27 TH	-23 21 32	+ 142	- 415.27	+ 0.70	- 0	36.1	- 29.6	6	19	32.0	
	28 FR	-23 19 10	+ 170	- 414.57	+ 0.84	- 1	5.7	- 29.4	6	23	28.5	
	29 SA	-23 16 20	+ 198	- 413.73	+ 0.98	- 1	35.1	- 29.2	6	27	25.1	
	30 SU	-23 13 2	+ 226	- 412.75	+ 1.12	- 2	4.3	- 29.0	6	31	21.6	
	31 MO	-23 9 16	+ 254	- 411.63	+ 1.25	- 2	33.2	- 28.7	6	35	18.2	
	32 TU	-23 5 2		- 410.38		- 3	1.9		6	39	14.8	

EQUATION OF TIME—PARTIAL DAY IN SECONDS

(Use sign of daily change.)



Note. Enter table with value of daily change to the nearest second and of GMT to the nearest 10 minutes. Do not interpolate for values more accurate than the nearest second.

Table 3. Equation of Time Graph

Table 4. Correction to Greenwich Mean Time Interval to Obtain Greenwich Sidereal Time Interval

GMT	0 ^h	1 ^h	2 ^h	3 ^h	4 ^h	5 ^h	6 ^h	7 ^h	8 ^h	9 ^h	10 ^h	11 ^h
m	m s	m s	m s	m s	m s	m s	m s	m s	m s	m s	m s	m s
0	0 0.0	0 9.0	0 19.7	0 29.6	0 39.4	0 49.3	0 59.1	1 9.0	1 18.9	1 28.7	1 38.6	1 48.4
1	0.2	10.0	19.9	29.7	39.6	49.4	59.3	9.2	19.0	28.9	38.7	48.6
2	0.3	10.2	20.0	29.9	39.8	49.6	59.5	9.3	19.2	29.0	38.9	48.8
3	0.5	10.3	20.2	30.1	39.9	49.8	59.6	9.5	19.3	29.2	39.1	48.9
4	0.7	10.5	20.4	30.2	40.1	49.9	59.8	9.7	19.5	29.4	39.2	49.1
5	0 0.8	0 10.7	0 20.5	0 30.4	0 40.2	0 50.1	1 0.0	1 9.8	1 19.7	1 29.5	1 39.4	1 49.2
6	1.0	10.8	20.7	30.6	40.4	50.3	0.1	10.0	19.8	29.7	39.6	49.4
7	1.2	11.0	20.9	30.7	40.6	50.4	0.3	10.1	20.0	29.9	39.7	49.6
8	1.3	11.2	21.0	30.9	40.7	50.6	0.5	10.3	20.2	30.0	39.9	49.7
9	1.5	11.3	21.2	31.0	40.9	50.8	0.6	10.5	20.3	30.2	40.0	49.9
10	0 1.6	0 11.5	0 21.4	0 31.2	0 41.1	0 50.9	1 0.8	1 10.6	1 20.5	1 30.4	1 40.2	1 50.1
11	1.8	11.7	21.5	31.4	41.2	51.1	0.9	10.8	20.7	30.5	40.4	50.2
12	2.0	11.8	21.7	31.5	41.4	51.3	1.1	11.0	20.8	30.7	40.5	50.4
13	2.1	12.0	21.8	31.7	41.6	51.4	1.3	11.1	21.0	30.8	40.7	50.6
14	2.3	12.2	22.0	31.9	41.7	51.6	1.4	11.3	21.2	31.0	40.9	50.7
15	0 2.5	0 12.3	0 22.2	0 32.0	0 41.9	0 51.7	1 1.6	1 11.5	1 21.3	1 31.2	1 41.0	1 50.9
16	2.6	12.5	22.3	32.2	42.1	51.9	1.8	11.6	21.5	31.3	41.2	51.0
17	2.8	12.6	22.5	32.4	42.2	52.1	1.9	11.8	21.6	31.5	41.4	51.2
18	3.0	12.8	22.7	32.5	42.4	52.2	2.1	12.0	21.8	31.7	41.5	51.4
19	3.1	13.0	22.8	32.7	42.5	52.4	2.3	12.1	22.0	31.8	41.7	51.5
20	0 3.3	0 13.1	0 23.0	0 32.9	0 42.7	0 52.6	1 2.4	1 12.3	1 22.1	1 32.0	1 41.8	1 51.7
21	3.4	13.3	23.2	33.0	42.9	52.7	2.6	12.4	22.3	32.2	42.0	51.9
22	3.6	13.5	23.3	33.2	43.0	52.9	2.8	12.6	22.5	32.3	42.2	52.0
23	3.8	13.6	23.5	33.3	43.2	53.1	2.9	12.8	22.6	32.5	42.3	52.2
24	3.9	13.8	23.7	33.5	43.4	53.2	3.1	12.9	22.8	32.7	42.5	52.4
25	0 4.1	0 14.0	0 23.8	0 33.7	0 43.5	0 53.4	1 3.2	1 13.1	1 23.0	1 32.8	1 42.7	1 52.5
26	4.3	14.1	24.0	33.8	43.7	53.6	3.4	13.3	23.1	33.0	42.8	52.7
27	4.4	14.3	24.1	34.0	43.9	53.7	3.6	13.4	23.3	33.1	43.0	52.9
28	4.6	14.5	24.3	34.2	44.0	53.9	3.7	13.6	23.5	33.3	43.2	53.0
29	4.8	14.6	24.5	34.3	44.2	54.0	3.9	13.8	23.6	33.5	43.3	53.2
30	0 4.9	0 14.8	0 24.6	0 34.5	0 44.4	0 54.2	1 4.1	1 13.9	1 23.8	1 33.6	1 43.5	1 53.3
31	5.1	14.9	24.8	34.7	44.5	54.4	4.2	14.1	23.9	33.8	43.7	53.5
32	5.3	15.1	25.0	34.8	44.7	54.5	4.4	14.3	24.1	34.0	43.8	53.7
33	5.4	15.3	25.1	35.0	44.8	54.7	4.6	14.4	24.3	34.1	44.0	53.8
34	5.6	15.4	25.3	35.2	45.0	54.9	4.7	14.6	24.4	34.3	44.2	54.0
35	0 5.8	0 15.6	0 25.5	0 35.3	0 45.2	0 55.0	1 4.9	1 14.7	1 24.6	1 34.5	1 44.3	1 54.2
36	5.9	15.8	25.6	35.5	45.3	55.2	5.1	14.9	24.8	34.6	44.5	54.3
37	6.1	15.9	25.8	35.6	45.5	55.4	5.2	15.1	24.9	34.8	44.6	54.5
38	6.2	16.1	26.0	35.8	45.7	55.5	5.4	15.2	25.1	35.0	44.8	54.7
39	6.4	16.3	26.1	36.0	45.8	55.7	5.5	15.4	25.3	35.1	45.0	54.8
40	0 6.6	0 16.4	0 26.3	0 36.1	0 46.0	0 55.9	1 5.7	1 15.6	1 25.4	1 35.3	1 45.1	1 55.0
41	6.7	16.6	26.4	36.3	46.2	56.0	5.9	15.7	25.6	35.4	45.3	55.2
42	6.9	16.8	26.6	36.5	46.3	56.2	6.0	15.9	25.8	35.6	45.5	55.3
43	7.1	16.9	26.8	36.6	46.5	56.3	6.2	16.1	25.9	35.8	45.6	55.5
44	7.2	17.1	26.9	36.8	46.7	56.5	6.4	16.2	26.1	35.9	45.8	55.6
45	0 7.4	0 17.2	0 27.1	0 37.0	0 46.8	0 56.7	1 6.5	1 16.4	1 26.2	1 36.1	1 46.0	1 55.8
46	7.6	17.4	27.3	37.1	47.0	56.8	6.7	16.6	26.4	36.3	46.1	56.0
47	7.7	17.6	27.4	37.3	47.1	57.0	6.9	16.7	26.6	36.4	46.3	56.1
48	7.9	17.7	27.6	37.5	47.3	57.2	7.0	16.9	26.7	36.6	46.4	56.3
49	8.0	17.9	27.8	37.6	47.5	57.3	7.2	17.0	26.9	36.8	46.6	56.5
50	0 8.2	0 18.1	0 27.9	0 37.8	0 47.6	0 57.5	1 7.4	1 17.2	1 27.1	1 36.9	1 46.8	1 56.6
51	8.4	18.2	28.1	37.9	47.8	57.7	7.5	17.4	27.2	37.1	46.9	56.8
52	8.5	18.4	28.3	38.1	48.0	57.8	7.7	17.5	27.4	37.3	47.1	57.0
53	8.7	18.6	28.4	38.3	48.1	58.0	7.8	17.7	27.6	37.4	47.3	57.1
54	8.9	18.7	28.6	38.4	48.3	58.2	8.0	17.9	27.7	37.6	47.4	57.3
55	0 9.0	0 18.9	0 28.7	0 38.6	0 48.5	0 58.3	1 8.2	1 18.0	1 27.9	1 37.7	1 47.6	1 57.5
56	9.2	19.1	28.9	38.8	48.6	58.5	8.3	18.2	28.1	37.9	47.8	57.6
57	9.4	19.2	29.1	38.9	48.8	58.6	8.5	18.4	28.2	38.1	47.9	57.8
58	9.5	19.4	29.2	39.1	49.0	58.8	8.7	18.5	28.4	38.2	48.1	57.9
59	9.7	19.5	29.4	39.3	49.1	59.0	8.8	18.7	28.5	38.4	48.3	58.1

Table 4. Correction to Greenwich Mean Time Interval to Obtain Greenwich Sidereal Time Interval—Continued

GMT	12 ^h	13 ^h	14 ^h	15 ^h	16 ^h	17 ^h	18 ^h	19 ^h	20 ^h	21 ^h	22 ^h	23 ^h
m	m s	m s	m s	m s	m s	m s	m s	m s	m s	m s	m s	m s
0	1 58.3	2 8.1	2 18.0	2 27.8	2 37.7	2 47.6	2 57.4	3 7.3	3 17.1	3 27.0	3 36.8	3 46.7
1	58.4	8.3	18.2	28.0	37.9	47.7	57.6	7.4	17.3	27.2	37.0	46.9
2	58.6	8.5	18.3	28.2	38.0	47.9	57.7	7.6	17.5	27.3	37.2	47.0
3	58.8	8.6	18.5	28.3	38.2	48.1	57.9	7.8	17.6	27.5	37.3	47.2
4	58.9	8.8	18.6	28.5	38.4	48.2	58.1	7.9	17.8	27.6	37.5	47.4
5	1 59.1	2 9.0	2 18.8	2 28.7	2 38.5	2 48.4	2 58.2	3 8.1	3 18.0	3 27.8	3 37.7	3 47.5
6	59.3	9.1	19.0	28.8	38.7	48.5	58.4	8.3	18.1	28.0	37.8	47.7
7	59.4	9.3	19.1	29.0	38.9	48.7	58.6	8.4	18.3	28.1	38.0	47.8
8	59.6	9.4	19.3	29.2	39.0	48.9	58.7	8.6	18.4	28.3	38.2	48.0
9	59.8	9.6	19.5	29.3	39.2	49.0	58.9	8.8	18.6	28.5	38.3	48.2
10	1 59.9	2 9.8	2 19.6	2 29.5	2 39.3	2 49.2	2 59.1	3 8.9	3 18.8	3 28.6	3 38.5	3 48.3
11	2 0.1	9.9	19.8	29.7	39.5	49.4	59.2	9.1	18.9	28.8	38.6	48.5
12	0.2	10.1	20.0	29.8	39.7	49.5	59.4	9.2	19.1	29.0	38.8	48.7
13	0.4	10.3	20.1	30.0	39.8	49.7	59.6	9.4	19.3	29.1	39.0	48.8
14	0.6	10.4	20.3	30.1	40.0	49.9	59.7	9.6	19.4	29.3	39.1	49.0
15	2 0.7	2 10.6	2 20.5	2 30.3	2 40.2	2 50.0	2 59.9	3 9.7	3 19.6	3 29.4	3 39.3	3 49.2
16	0.9	10.8	20.6	30.5	40.3	50.2	3 0.0	9.9	19.8	29.6	39.5	49.3
17	1.1	10.9	20.8	30.6	40.5	50.4	0.2	10.1	19.9	29.8	39.6	49.5
18	1.2	11.1	20.9	30.8	40.7	50.5	0.4	10.2	20.1	29.9	39.8	49.7
19	1.4	11.3	21.1	31.0	40.8	50.7	0.5	10.4	20.3	30.1	40.0	49.8
20	2 1.6	2 11.4	2 21.3	2 31.1	2 41.0	2 50.8	3 0.7	3 10.6	3 20.4	3 30.3	3 40.1	3 50.0
21	1.7	11.6	21.4	31.3	41.2	51.0	0.9	10.7	20.6	30.4	40.3	50.1
22	1.9	11.7	21.6	31.5	41.3	51.2	1.0	10.9	20.7	30.6	40.5	50.3
23	2.1	11.9	21.8	31.6	41.5	51.3	1.2	11.1	20.9	30.8	40.6	50.5
24	2.2	12.1	21.9	31.8	41.6	51.5	1.4	11.2	21.1	30.9	40.8	50.6
25	2 2.4	2 12.2	2 22.1	2 32.0	2 41.8	2 51.7	3 1.5	3 11.4	3 21.2	3 31.1	3 40.9	3 50.8
26	2.5	12.4	22.3	32.1	42.0	51.8	1.7	11.5	21.4	31.3	41.1	51.0
27	2.7	12.6	22.4	32.3	42.1	52.0	1.9	11.7	21.6	31.4	41.3	51.1
28	2.9	12.7	22.6	32.4	42.3	52.2	2.0	11.9	21.7	31.6	41.4	51.3
29	3.0	12.9	22.8	32.6	42.5	52.3	2.2	12.0	21.9	31.8	41.6	51.5
30	2 3.2	2 13.1	2 22.9	2 32.8	2 42.6	2 52.5	3 2.3	3 12.2	3 22.1	3 31.9	3 41.8	3 51.6
31	3.4	13.2	23.1	32.9	42.8	52.7	2.5	12.4	22.2	32.1	41.9	51.8
32	3.5	13.4	23.2	33.1	43.0	52.8	2.7	12.5	22.4	32.2	42.1	52.0
33	3.7	13.6	23.4	33.3	43.1	53.0	2.8	12.7	22.6	32.4	42.3	52.1
34	3.9	13.7	23.6	33.4	43.3	53.1	3.0	12.9	22.7	32.6	42.4	52.3
35	2 4.0	2 13.9	2 23.7	2 33.6	2 43.5	2 53.3	3 3.2	3 13.0	3 22.9	3 32.7	3 42.6	3 52.4
36	4.2	14.0	23.9	33.8	43.6	53.5	3.3	13.2	23.0	32.9	42.8	52.6
37	4.4	14.2	24.1	33.9	43.8	53.6	3.5	13.4	23.2	33.1	42.9	52.8
38	4.5	14.4	24.2	34.1	43.9	53.8	3.7	13.5	23.4	33.2	43.1	52.9
39	4.7	14.5	24.4	34.3	44.1	54.0	3.8	13.7	23.5	33.4	43.2	53.1
40	2 4.8	2 14.7	2 24.6	2 34.4	2 44.3	2 54.1	3 4.0	3 13.8	3 23.7	3 33.6	3 43.4	3 53.3
41	5.0	14.9	24.7	34.6	44.4	54.3	4.2	14.0	23.9	33.7	43.6	53.4
42	5.2	15.0	24.9	34.7	44.6	54.5	4.3	14.2	24.0	33.9	43.7	53.6
43	5.3	15.2	25.1	34.9	44.8	54.6	4.5	14.3	24.2	34.0	43.9	53.8
44	5.5	15.4	25.2	35.1	44.9	54.8	4.6	14.5	24.4	34.2	44.1	53.9
45	2 5.7	2 15.5	2 25.4	2 35.2	2 45.1	2 55.0	3 4.8	3 14.7	3 24.5	3 34.4	3 44.2	3 54.1
46	5.8	15.7	25.5	35.4	45.3	55.1	5.0	14.8	24.7	34.5	44.4	54.3
47	6.0	15.9	25.7	35.6	45.4	55.3	5.1	15.0	24.8	34.7	44.6	54.4
48	6.2	16.0	25.9	35.7	45.6	55.4	5.3	15.2	25.0	34.9	44.7	54.6
49	6.3	16.2	26.0	35.9	45.8	55.6	5.5	15.3	25.2	35.0	44.9	54.7
50	2 6.5	2 16.3	2 26.2	2 36.1	2 45.9	2 55.8	3 5.6	3 15.5	3 25.3	3 35.2	3 45.1	3 54.9
51	6.7	16.5	26.4	36.2	46.1	55.9	5.8	15.7	25.5	35.4	45.2	55.1
52	6.8	16.7	26.5	36.4	46.2	56.1	6.0	15.8	25.7	35.5	45.4	55.2
53	7.0	16.8	26.7	36.6	46.4	56.3	6.1	16.0	25.8	35.7	45.5	55.4
54	7.1	17.0	26.9	36.7	46.6	56.4	6.3	16.1	26.0	35.9	45.7	55.6
55	2 7.3	2 17.2	2 27.0	2 36.9	2 46.7	2 56.6	3 6.5	3 16.3	3 26.2	3 36.0	3 45.9	3 55.7
56	7.5	17.3	27.2	37.0	46.9	56.8	6.6	16.5	26.3	36.2	46.0	55.9
57	7.6	17.5	27.4	37.2	47.1	56.9	6.8	16.6	26.5	36.4	46.2	56.1
58	7.8	17.7	27.5	37.4	47.2	57.1	6.9	16.8	26.7	36.5	46.4	56.2
59	8.0	17.8	27.7	37.5	47.4	57.3	7.1	17.0	26.8	36.7	46.5	56.4

Table 5a. Conversion of Time to Arc

Time			Arc			Time			Arc			Time			Arc		
Hours	°	Mils	Min	°	Mils	Min	°	Mils	Min	°	Mils	Min	°	Mils	Min	°	Mils
1	15	229.67	1	0	15	4.44	21	5	15	99.29	41	10	15	109.29			
2	30	459.33	2	0	30	8.89	22	5	30	97.79	42	10	30	109.67			
3	45	689.00	3	0	45	13.33	23	5	45	102.22	43	10	45	109.11			
4	60	919.67	4	1	00	17.78	24	6	00	103.67	44	11	00	109.53			
5	75	1150.33	5	1	15	22.22	25	6	15	111.11	45	11	15	109.00			
6	90	1380.00	6	1	30	26.67	26	6	30	115.53	46	11	30	109.44			
7	105	1610.67	7	1	45	31.11	27	6	45	120.00	47	11	45	109.89			
8	120	1840.33	8	2	00	35.56	28	7	00	124.44	48	12	00	109.33			
9	135	2070.00	9	2	15	40.00	29	7	15	128.89	49	12	15	109.77			
10	150	2300.67	10	2	30	44.44	30	7	30	133.33	50	12	30	109.22			
11	165	2530.33	11	2	45	48.89	31	7	45	137.78	51	12	45	109.67			
12	180	2760.00	12	3	00	53.33	32	8	00	142.22	52	13	00	109.11			
13	195	2990.67	13	3	15	57.78	33	8	15	146.67	53	13	15	109.53			
14	210	3220.33	14	3	30	62.22	34	8	30	151.11	54	13	30	109.00			
15	225	3450.00	15	3	45	66.67	35	8	45	155.56	55	13	45	109.44			
16	240	3680.67	16	4	00	71.11	36	9	00	160.00	56	14	00	109.89			
17	255	3910.33	17	4	15	75.56	37	9	15	164.44	57	14	15	109.33			
18	270	4140.00	18	4	30	80.00	38	9	30	168.89	58	14	30	109.77			
19	285	4370.67	19	4	45	84.44	39	9	45	173.33	59	14	45	109.22			
20	300	4600.33	20	5	00	88.89	40	10	00	177.78	60	15	00	109.67			
21	315	4830.00															
22	330	5060.67															
23	345	5290.33															
24	360	5520.00															

Time				Arc				Time				Arc				Time				Arc			
Sec	'	"	Mils	Sec	'	"	Mils	Sec	'	"	Mils	Sec	'	"	Mils	Sec	'	"	Mils	Sec	'	"	Mils
1	0	15	.07	16	4	00	1.19	31	7	45	2.30	46	11	30	3.41								
2	0	30	.15	17	4	15	1.23	32	8	00	2.37	47	11	45	3.49								
3	0	45	.22	18	4	30	1.28	33	8	15	2.44	48	12	00	3.59								
4	1	00	.30	19	4	45	1.41	34	8	30	2.52	49	12	15	3.63								
5	1	15	.37	20	5	00	1.48	35	8	45	2.59	50	12	30	3.70								
6	1	30	.44	21	5	15	1.53	36	9	00	2.67	51	12	45	3.78								
7	1	45	.52	22	5	30	1.63	37	9	15	2.74	52	13	00	3.85								
8	2	00	.59	23	5	45	1.70	38	9	30	2.81	53	13	15	3.93								
9	2	15	.67	24	6	00	1.78	39	9	45	2.89	54	13	30	4.00								
10	2	30	.74	25	6	15	1.85	40	10	00	2.93	55	13	45	4.07								
11	2	45	.81	26	6	30	1.93	41	10	15	3.04	56	14	00	4.15								
12	3	00	.89	27	6	45	2.00	42	10	30	3.11	57	14	15	4.22								
13	3	15	.98	28	7	00	2.07	43	10	45	3.19	58	14	30	4.30								
14	3	30	1.04	29	7	15	2.15	44	11	00	3.28	59	14	45	4.37								
15	3	45	1.11	30	7	30	2.22	45	11	15	3.33	60	15	00	4.44								

Example: Time is 22 hours, 46 minutes, 37 seconds. Convert to arc.

22 hours time = 330° arc

46 minutes time = 11° 30' arc

37 seconds time = 9' 15" arc

22° 46' 37" 341° 39' 15" arc

Table 5b. Conversion of Arc to Time

DEGREES						MINUTES			SECONDS					
°	h	m	°	h	m	°	h	m	°	s	°	s	°	s
0	0	00	60	4	00	120	8	00	0	0 000	0 00	0 000	0 50	0 033
1	0	04	61	4	04	121	8	04	1	0 067	.01	.001	.51	.034
2	0	08	62	4	08	122	8	08	2	0 133	.02	.001	.52	.035
3	0	12	63	4	12	123	8	12	3	0 200	.03	.002	.53	.035
4	0	16	64	4	16	124	8	16	4	0 267	.04	.003	.54	.036
5	0	20	65	4	20	125	8	20	5	0 333	0 05	0 003	0 55	0 037
6	0	24	66	4	24	126	8	24	6	0 400	.06	.004	.56	.037
7	0	28	67	4	28	127	8	28	7	0 467	.07	.005	.57	.038
8	0	32	68	4	32	128	8	32	8	0 533	.08	.005	.58	.039
9	0	36	69	4	36	129	8	36	9	0 600	.09	.006	.59	.039
10	0	40	70	4	40	130	8	40	10	0 667	0 10	0 007	0 60	0 040
11	0	44	71	4	44	131	8	44	11	0 733	.11	.007	.61	.041
12	0	48	72	4	48	132	8	48	12	0 800	.12	.008	.62	.041
13	0	52	73	4	52	133	8	52	13	0 867	.13	.009	.63	.042
14	0	56	74	4	56	134	8	56	14	0 933	.14	.009	.64	.043
15	1	00	75	5	00	135	9	00	15	1 000	0 15	0 010	0 65	0 043
16	1	04	76	5	04	136	9	04	16	1 067	.16	.011	.66	.044
17	1	08	77	5	08	137	9	08	17	1 133	.17	.011	.67	.045
18	1	12	78	5	12	138	9	12	18	1 200	.18	.012	.68	.045
19	1	16	79	5	16	139	9	16	19	1 267	.19	.013	.69	.046
20	1	20	80	5	20	140	9	20	20	1 333	0 20	0 013	0 70	0 047
21	1	24	81	5	24	141	9	24	21	1 400	.21	.014	.71	.047
22	1	28	82	5	28	142	9	28	22	1 467	.22	.015	.72	.048
23	1	32	83	5	32	143	9	32	23	1 533	.23	.015	.73	.049
24	1	36	84	5	36	144	9	36	24	1 600	.24	.016	.74	.049
25	1	40	85	5	40	145	9	40	25	1 667	0 25	0 017	0 75	0 050
26	1	44	86	5	44	146	9	44	26	1 733	.26	.017	.76	.051
27	1	48	87	5	48	147	9	48	27	1 800	.27	.018	.77	.051
28	1	52	88	5	52	148	9	52	28	1 867	.28	.019	.78	.052
29	1	56	89	5	56	149	9	56	29	1 933	.29	.019	.79	.053
30	2	00	90	6	00	150	10	00	30	2 000	0 30	0 020	0 80	0 053
31	2	04	91	6	04	151	10	04	31	2 067	.31	.021	.81	.054
32	2	08	92	6	08	152	10	08	32	2 133	.32	.021	.82	.055
33	2	12	93	6	12	153	10	12	33	2 200	.33	.022	.83	.055
34	2	16	94	6	16	154	10	16	34	2 267	.34	.023	.84	.056
35	2	20	95	6	20	155	10	20	35	2 333	0 35	0 023	0 85	0 057
36	2	24	96	6	24	156	10	24	36	2 400	.36	.024	.86	.057
37	2	28	97	6	28	157	10	28	37	2 467	.37	.025	.87	.058
38	2	32	98	6	32	158	10	32	38	2 533	.38	.025	.88	.059
39	2	36	99	6	36	159	10	36	39	2 600	.39	.026	.89	.059
40	2	40	100	6	40	160	10	40	40	2 667	0 40	0 027	0 90	0 060
41	2	44	101	6	44	161	10	44	41	2 733	.41	.027	.91	.061
42	2	48	102	6	48	162	10	48	42	2 800	.42	.028	.92	.061
43	2	52	103	6	52	163	10	52	43	2 867	.43	.029	.93	.062
44	2	56	104	6	56	164	10	56	44	2 933	.44	.029	.94	.063
45	3	00	105	7	00	165	11	00	45	3 000	0 45	0 030	0 95	0 063
46	3	04	106	7	04	166	11	04	46	3 067	.46	.031	.96	.064
47	3	08	107	7	08	167	11	08	47	3 133	.47	.031	.97	.065
48	3	12	108	7	12	168	11	12	48	3 200	.48	.032	.98	.065
49	3	16	109	7	16	169	11	16	49	3 267	.49	.033	.99	.066
50	3	20	110	7	20	170	11	20	50	3 333	0 50	0 033	1 00	0 067
51	3	24	111	7	24	171	11	24	51	3 400				
52	3	28	112	7	28	172	11	28	52	3 467				
53	3	32	113	7	32	173	11	32	53	3 533				
54	3	36	114	7	36	174	11	36	54	3 600				
55	3	40	115	7	40	175	11	40	55	3 667				
56	3	44	116	7	44	176	11	44	56	3 733				
57	3	48	117	7	48	177	11	48	57	3 800				
58	3	52	118	7	52	178	11	52	58	3 867				
59	3	56	119	7	56	179	11	56	59	3 933				

90° = 6^h180° = 12^h270° = 18^h

Table 5c. Conversion of Degrees, Minutes, and Seconds to Mils

Degrees											
Deg	Mils	Deg	Mils	Deg	Mils	Deg	Mils	Deg	Mils	Deg	Mils
1	17.78	31	551.11	61	1084.44	91	1617.78	121	2151.11	151	2684.44
2	35.56	32	568.89	62	1102.22	92	1635.56	122	2168.89	152	2702.22
3	53.33	33	586.67	63	1120.00	93	1653.33	123	2186.67	153	2720.00
4	71.11	34	604.44	64	1137.78	94	1671.11	124	2204.44	154	2737.78
5	88.89	35	622.22	65	1155.56	95	1688.89	125	2222.22	155	2755.56
6	106.67	36	640.00	66	1173.33	96	1706.67	126	2240.00	156	2773.33
7	124.44	37	657.78	67	1191.11	97	1724.44	127	2257.78	157	2791.11
8	142.22	38	675.56	68	1208.89	98	1742.22	128	2275.56	158	2808.89
9	160.00	39	693.33	69	1226.67	99	1760.00	129	2293.33	159	2826.67
10	177.78	40	711.11	70	1244.44	100	1777.78	130	2311.11	160	2844.44
11	195.56	41	728.89	74	1262.22	101	1795.56	131	2328.89	161	2862.22
12	213.33	42	746.67	72	1280.00	102	1813.33	132	2346.67	162	2880.00
13	231.11	43	764.44	73	1297.78	103	1831.11	133	2364.44	163	2897.78
14	248.89	44	782.22	74	1315.56	104	1848.89	134	2382.22	164	2915.56
15	266.67	45	800.00	75	1333.33	105	1866.67	135	2400.00	165	2933.33
16	284.44	46	817.78	76	1351.11	106	1884.44	136	2417.78	166	2951.11
17	302.22	47	835.56	77	1368.89	107	1902.22	137	2435.56	167	2968.89
18	320.00	48	853.33	78	1386.67	108	1920.00	138	2453.33	168	2986.67
19	337.78	49	871.11	79	1404.44	109	1937.78	139	2471.11	169	3004.44
20	355.56	50	888.89	80	1422.22	110	1955.56	140	2488.89	170	3022.22
21	373.33	51	906.67	81	1440.00	111	1973.33	141	2506.67	171	3040.00
22	391.11	52	924.44	82	1457.78	112	1991.11	142	2524.44	172	3057.78
23	408.89	53	942.22	83	1475.56	113	2008.89	143	2542.22	173	3075.56
24	426.67	54	960.00	84	1493.33	114	2026.67	144	2560.00	174	3093.33
25	444.44	55	977.78	85	1511.11	115	2044.44	145	2577.78	175	3111.11
26	462.22	56	995.56	86	1528.89	116	2062.22	146	2595.56	176	3128.89
27	480.00	57	1013.33	87	1546.67	117	2080.00	147	2613.33	177	3146.67
28	497.78	58	1031.11	88	1564.44	118	2097.78	148	2631.11	178	3164.44
29	515.56	59	1048.89	89	1582.22	119	2115.56	149	2648.89	179	3182.22
30	533.33	60	1066.67	90	1600.00	120	2133.33	150	2666.67	180	3200.00

Minutes						Seconds					
Min	Mils	Min	Mils	Min	Mils	Sec	Mils	Sec	Mils	Sec	Mils
1	0.30	21	6.22	41	12.15	1	0.00	21	0.10	41	0.20
2	0.59	22	6.52	42	12.44	2	0.01	22	0.11	42	0.21
3	0.89	23	6.81	43	12.74	3	0.01	23	0.11	43	0.21
4	1.19	24	7.11	44	13.04	4	0.02	24	0.12	44	0.22
5	1.48	25	7.41	45	13.33	5	0.02	25	0.12	45	0.22
6	1.78	26	7.70	46	13.63	6	0.03	26	0.13	46	0.23
7	2.07	27	8.00	47	13.93	7	0.03	27	0.13	47	0.23
8	2.37	28	8.30	48	14.22	8	0.04	28	0.14	48	0.24
9	2.67	29	8.59	49	14.52	9	0.04	29	0.14	49	0.24
10	2.96	30	8.89	50	14.81	10	0.05	30	0.15	50	0.25
11	3.26	31	9.19	51	15.11	11	0.05	31	0.15	51	0.25
12	3.56	32	9.48	52	15.41	12	0.06	32	0.16	52	0.26
13	3.85	33	9.78	53	15.70	13	0.06	33	0.16	53	0.26
14	4.15	34	10.07	54	16.00	14	0.07	34	0.17	54	0.27
15	4.44	35	10.37	55	16.30	15	0.07	35	0.17	55	0.27
16	4.74	36	10.67	56	16.59	16	0.08	36	0.18	56	0.28
17	5.04	37	10.96	57	16.89	17	0.08	37	0.18	57	0.28
18	5.33	38	11.26	58	17.19	18	0.09	38	0.19	58	0.29
19	5.63	39	11.56	59	17.48	19	0.09	39	0.19	59	0.29
20	5.93	40	11.85	60	17.78	20	0.10	40	0.20	60	0.30

Table 6. Convergence

Northing = UTM grid northing coordinate of station in meters.

If in Northern Hemisphere, enter table with northing.

If in Southern Hemisphere, subtract northing of station from 10,000,000; enter table with resulting northing.

Enter table using northing to nearest 100 meters and interpolate.

Log XV = Log of function XV (sign always +).

Northing	Function XV	Diff.	Log XV	Diff.	Northing	Function XV	Diff.	Log XV	Diff.
0	0		0		310,000	1585.0	51.2	3.20003	1426
1,000	5.109	5.109	0.70834	70834	320,000	1636.3	51.3	3.21386	1383
2,000	10.218	5.109	1.00937	30103	330,000	1687.5	51.2	3.22724	1338
3,000	15.327	5.109	1.18546	17609	340,000	1738.7	51.2	3.24022	1298
4,000	20.436	5.109	1.31040	12494	350,000	1789.9	51.2	3.25283	1261
5,000	25.545	5.109	1.40731	9691	360,000	1841.2	51.3	3.26510	1227
6,000	30.654	5.109	1.48649	7918	370,000	1892.4	51.2	3.27701	1191
7,000	35.763	5.109	1.55343	6694	380,000	1943.7	51.3	3.28863	1162
8,000	40.872	5.109	1.61143	5800	390,000	1995.0	51.3	3.29994	1131
9,000	45.981	5.109	1.66258	5115	400,000	2046.3	51.3	3.31097	1103
10,000	51.090	5.109	1.70834	4576	410,000	2097.6	51.3	3.32172	1075
20,000	102.18	51.09	2.00937	30103	420,000	2148.9	51.3	3.33222	1050
30,000	153.27	51.09	2.18546	17609	430,000	2200.2	51.3	3.34246	1024
40,000	204.36	51.09	2.31040	12494	440,000	2251.5	51.3	3.35247	1001
50,000	255.46	51.10	2.40732	9692	450,000	2302.9	51.4	3.36228	981
60,000	306.55	51.09	2.48650	7918	460,000	2354.2	51.3	3.37184	956
70,000	357.65	51.10	2.55346	6696	470,000	2405.6	51.4	3.38122	938
80,000	408.74	51.09	2.61145	5799	480,000	2456.9	51.3	3.39039	917
90,000	459.84	51.10	2.66261	5116	490,000	2508.3	51.4	3.39938	899
100,000	510.94	51.10	2.70837	4576	500,000	2559.7	51.4	3.40819	881
110,000	562.05	51.11	2.74978	4141	510,000	2611.1	51.4	3.41682	863
120,000	613.15	51.10	2.78757	3779	520,000	2662.6	51.5	3.42531	849
130,000	664.26	51.11	2.82234	3477	530,000	2714.0	51.4	3.43361	830
140,000	715.38	51.12	2.85454	3220	540,000	2765.4	51.4	3.44176	815
150,000	766.49	51.11	2.88451	2997	550,000	2816.9	51.5	3.44977	801
160,000	817.61	51.12	2.91255	2804	560,000	2868.4	51.5	3.45764	787
170,000	868.74	51.13	2.93889	2634	570,000	2919.9	51.5	3.46537	773
180,000	919.87	51.13	2.96373	2484	580,000	2971.4	51.5	3.47296	759
190,000	971.00	51.13	2.98722	2349	590,000	3022.9	51.5	3.48042	746
200,000	1022.1	51.1	3.00949	2227	600,000	3074.4	51.5	3.48776	734
210,000	1073.3	51.2	3.03072	2123	610,000	3126.0	51.6	3.49499	723
220,000	1124.4	51.1	3.05092	2020	620,000	3177.5	51.5	3.50209	710
230,000	1175.6	51.2	3.07026	1934	630,000	3229.1	51.6	3.50908	699
240,000	1226.7	51.1	3.08874	1848	640,000	3280.7	51.6	3.51597	689
250,000	1277.9	51.2	3.10650	1776	650,000	3332.3	51.6	3.52274	677
260,000	1329.1	51.2	3.12356	1706	660,000	3384.0	51.7	3.52943	669
270,000	1380.3	51.2	3.13997	1641	670,000	3435.6	51.6	3.53600	657
280,000	1431.4	51.1	3.15576	1579	680,000	3487.3	51.7	3.54249	649
290,000	1482.6	51.2	3.17102	1526	690,000	3539.0	51.7	3.54888	639
300,000	1533.8	51.2	3.18577	1475	700,000	3590.7	51.7	3.55518	630

Table 6. Convergence—Continued

Northings	Function XV	Diff.	Log XV	Diff.	Northings	Function XV	Diff.	Log XV	Diff.
700,000	3500.7	51.7	3.55518	630					
710,000	3642.4	51.7	3.56139	621	1,160,000	5092.3	52.8	3.77750	384
720,000	3694.1	51.7	3.56751	612	1,170,000	6045.1	52.8	3.78140	381
730,000	3745.9	51.8	3.57356	605	1,180,000	6098.0	52.9	3.78519	379
740,000	3797.6	51.7	3.57951	595	1,190,000	6150.9	52.9	3.78894	375
750,000	3849.4	51.8	3.58539	588	1,200,000	6203.8	52.9	3.79283	372
760,000	3901.2	51.8	3.59120	581	1,210,000	6256.7	52.9	3.79635	369
770,000	3953.1	51.9	3.59704	574	1,220,000	6309.7	53.0	3.80001	366
780,000	4004.9	51.8	3.60250	565	1,230,000	6362.7	53.0	3.80364	363
790,000	4056.8	51.9	3.60818	559	1,240,000	6415.8	53.1	3.80725	361
800,000	4108.7	51.9	3.61370	552	1,250,000	6468.8	53.0	3.81082	357
810,000	4160.6	51.9	3.61916	546	1,260,000	6521.9	53.1	3.81437	355
820,000	4212.5	51.9	3.62454	538	1,270,000	6575.1	53.2	3.81780	353
830,000	4264.4	51.9	3.62986	532	1,280,000	6628.3	53.2	3.82140	350
840,000	4316.4	52.0	3.63512	526	1,290,000	6681.5	53.2	3.82487	347
850,000	4368.4	52.0	3.64032	520	1,300,000	6734.7	53.2	3.82832	345
860,000	4420.4	52.0	3.64546	514	1,310,000	6788.0	53.3	3.83174	342
870,000	4472.5	52.1	3.65055	509	1,320,000	6841.3	53.3	3.83514	340
880,000	4524.5	52.0	3.65557	502	1,330,000	6894.7	53.4	3.83852	338
890,000	4576.6	52.1	3.66054	497	1,340,000	6948.0	53.3	3.84188	334
900,000	4628.7	52.1	3.66546	492	1,350,000	7001.3	53.5	3.84519	333
910,000	4680.8	52.1	3.67032	486	1,360,000	7054.9	53.4	3.84849	330
920,000	4733.0	52.2	3.67514	482	1,370,000	7108.4	53.5	3.85177	328
930,000	4785.2	52.2	3.67980	476	1,380,000	7161.9	53.5	3.85503	326
940,000	4837.3	52.1	3.68460	470	1,390,000	7215.5	53.6	3.85827	324
950,000	4889.6	52.3	3.68927	467	1,400,000	7269.1	53.6	3.86148	321
960,000	4941.8	52.2	3.69389	462	1,410,000	7322.7	53.6	3.86467	319
970,000	4994.1	52.3	3.69846	457	1,420,000	7376.4	53.7	3.86784	317
980,000	5046.4	52.3	3.70298	452	1,430,000	7430.1	53.7	3.87099	315
990,000	5098.7	52.3	3.70746	448	1,440,000	7483.9	53.8	3.87413	314
1,000,000	5151.1	52.4	3.71180	444	1,450,000	7537.7	53.8	3.87724	311
1,010,000	5203.4	52.3	3.71629	439	1,460,000	7591.5	53.8	3.88033	309
1,020,000	5255.8	52.4	3.72084	435	1,470,000	7645.4	53.9	3.88340	307
1,030,000	5308.2	52.4	3.72495	431	1,480,000	7699.3	53.9	3.88645	305
1,040,000	5360.7	52.5	3.72922	427	1,490,000	7753.2	53.9	3.88948	303
1,050,000	5413.2	52.5	3.73345	423	1,500,000	7807.2	54.0	3.89250	302
1,060,000	5465.7	52.5	3.73765	420	1,510,000	7861.2	54.0	3.89549	299
1,070,000	5518.2	52.5	3.74180	415	1,520,000	7915.3	54.1	3.89847	298
1,080,000	5570.8	52.6	3.74592	412	1,530,000	7969.4	54.1	3.90143	296
1,090,000	5623.4	52.6	3.75000	408	1,540,000	8023.6	54.2	3.90437	294
1,100,000	5676.0	52.6	3.75404	404	1,550,000	8077.8	54.2	3.90729	292
1,110,000	5728.6	52.6	3.75805	401	1,560,000	8132.0	54.2	3.91020	291
1,120,000	5781.3	52.7	3.76203	398	1,570,000	8186.3	54.3	3.91309	289
1,130,000	5834.0	52.7	3.76597	394	1,580,000	8240.6	54.3	3.91593	287
1,140,000	5886.7	52.7	3.76987	390	1,590,000	8294.9	54.3	3.91881	285
1,150,000	5939.8	52.8	3.77375	388	1,600,000	8349.3	54.4	3.92165	284

Table 6. Convergence—Continued

Normaling	Percentages	Dist.	Log XV	Dist.	Normaling	Percentages	Dist.	Log XV	Dist.
1,000,000	0410.9	54.4	3.02169	234					
1,010,000	0409.0	54.8	3.02440	233	2,020,000	10004	53	4.03789	224
1,020,000	0407.9	54.8	3.02720	230	2,070,000	10231	57	4.03904	223
1,030,000	0407.0	54.8	3.03007	270	2,020,000	11010	57	4.04310	225
1,040,000	0407.4	54.6	3.03289	270	2,020,000	11075	57	4.04334	224
1,050,000	0407.0	54.6	3.03561	270	2,100,000	11132	57	4.04687	223
1,060,000	0407.7	54.7	3.03835	274	2,110,000	11150	57	4.04970	222
1,070,000	0407.4	54.7	3.04103	273	2,120,000	11240	57	4.05100	221
1,080,000	0407.2	54.6	3.04350	272	2,130,000	11203	57	4.05310	210
1,090,000	0411.0	54.6	3.04650	270	2,140,000	11361	53	4.05542	223
1,700,000	0509.9	54.9	3.04919	260	2,150,000	11416	57	4.05750	217
1,710,000	0509.6	54.9	3.05189	267	2,160,000	11478	57	4.05978	210
1,720,000	0509.7	54.9	3.05452	264	2,170,000	11533	53	4.06194	210
1,730,000	0509.7	55.0	3.05716	264	2,180,000	11590	57	4.06408	214
1,740,000	0511.7	55.0	3.05979	263	2,190,000	11645	53	4.06626	217
1,750,000	05170.0	55.1	3.06241	262	2,200,000	11705	57	4.06837	212
1,760,000	0526.0	55.2	3.06501	260	2,210,000	11763	53	4.07062	216
1,770,000	05261.2	55.2	3.06760	259	2,220,000	11821	53	4.07293	213
1,780,000	0536.4	55.2	3.07018	259	2,230,000	11879	53	4.07470	213
1,790,000	05361.7	55.3	3.07274	256	2,240,000	11937	53	4.07660	212
1,800,000	0547.0	55.3	3.07539	255	2,250,000	11996	53	4.07850	210
1,810,000	05502.4	55.4	3.07763	254	2,260,000	12053	53	4.08110	210
1,820,000	0557.9	55.5	3.08036	253	2,270,000	12111	53	4.08310	203
1,830,000	05613.4	55.5	3.08299	252	2,280,000	12169	53	4.08526	207
1,840,000	05645.0	55.5	3.08536	250	2,290,000	12227	53	4.08732	207
1,850,000	05724.6	55.6	3.08767	249	2,300,000	12285	53	4.08930	203
1,860,000	05780.1	55.6	3.09034	247	2,310,000	12344	50	4.09146	203
1,870,000	05835.6	55.7	3.09281	247	2,320,000	12402	53	4.09349	203
1,880,000	05891.0	55.8	3.09527	246	2,330,000	12461	50	4.09558	203
1,890,000	05947.4	55.8	3.09771	244	2,340,000	12519	53	4.09757	202
1,900,000	10000	55.8	4.00013	242	2,350,000	12578	50	4.09931	204
1,910,000	10050	56	4.00255	242	2,360,000	12636	53	4.10161	200
1,920,000	10115	56	4.00497	242	2,370,000	12695	50	4.10363	202
1,930,000	10171	56	4.00736	239	2,380,000	12754	50	4.10565	202
1,940,000	10227	56	4.00973	239	2,390,000	12813	50	4.10765	200
1,950,000	10283	56	4.01212	237	2,400,000	12872	50	4.10965	200
1,960,000	10339	56	4.01448	236	2,410,000	12931	50	4.11163	193
1,970,000	10393	57	4.01687	230	2,420,000	12990	50	4.11361	193
1,980,000	10452	56	4.01920	233	2,430,000	13049	50	4.11559	197
1,990,000	10509	56	4.02152	232	2,440,000	13109	60	4.11757	199
2,000,000	10565	57	4.02387	235	2,450,000	13168	50	4.11952	196
2,010,000	10621	56	4.02617	230	2,460,000	13228	60	4.12149	197
2,020,000	10678	57	4.02849	232	2,470,000	13287	50	4.12343	194
2,030,000	10734	56	4.03070	227	2,480,000	13347	60	4.12538	196
2,040,000	10791	57	4.03303	220	2,490,000	13405	50	4.12730	192
2,050,000	10848	57	4.03535	229	2,500,000	13465	60	4.12924	194

Table 6. Convergence—Continued

Northing	Function XV	Diff.	Log XV	Diff.	Northing	Function XV	Diff.	Log XV	Diff.
2,500,000	13466	60	4.12924	194					
		60		193			63	4.21232	168
2,510,000	13526	60	4.13117	192	2,960,000	16305	64	4.21402	170
2,520,000	13586	60	4.13300	192	2,970,000	16369	64	4.21572	170
2,530,000	13646	60	4.13501	190	2,980,000	16433	64	4.21740	168
2,540,000	13706	60	4.13691	190	2,990,000	16497	64	4.21909	169
2,550,000	13766	60	4.13881	189	3,000,000	16561	65		
		60		188			65	4.22079	170
2,560,000	13826	60	4.14070	188	3,010,000	16626	64	4.22246	167
2,570,000	13886	61	4.14258	190	3,020,000	16690	65	4.22414	168
2,580,000	13947	60	4.14448	187	3,030,000	16755	64	4.22580	166
2,590,000	14007	61	4.14635	188	3,040,000	16819	65	4.22748	168
2,600,000	14068	60	4.14823	185	3,050,000	16884	65		
		61		187			65	4.22914	166
2,610,000	14128	61	4.15008	186	3,060,000	16949	65	4.23081	165
2,620,000	14189	61	4.15195	186	3,070,000	17014	65	4.23246	165
2,630,000	14250	61	4.15381	185	3,080,000	17079	65	4.23411	165
2,640,000	14311	61	4.15567	184	3,090,000	17144	65	4.23576	163
2,650,000	14372	61	4.15752	183	3,100,000	17209	66		
		61		182			66	4.23739	166
2,660,000	14433	61	4.15936	182	3,110,000	17274	66	4.23905	165
2,670,000	14494	61	4.16110	182	3,120,000	17340	65	4.24070	162
2,680,000	14555	61	4.16301	184	3,130,000	17406	66	4.24232	164
2,690,000	14616	62	4.16483	180	3,140,000	17471	66		
2,700,000	14678	61	4.16667	182	3,150,000	17537	66	4.24559	162
		62		179			66	4.24721	162
2,710,000	14739	61	4.16847	181	3,160,000	17603	66	4.24883	161
2,720,000	14801	62	4.17029	180	3,170,000	17669	67	4.25044	164
2,730,000	14862	62	4.17208	178	3,180,000	17735	66		
2,740,000	14924	62	4.17389	177	3,190,000	17801	66	4.25208	160
2,750,000	14986	62	4.17569	176	3,200,000	17868	67		
		62		175			67	4.25368	162
2,760,000	15048	62	4.17748	178	3,210,000	17934	66	4.25530	159
2,770,000	15110	62	4.17926	177	3,220,000	18001	66	4.25689	160
2,780,000	15172	62	4.18104	177	3,230,000	18067	67	4.25849	161
2,790,000	15234	62	4.18281	174	3,240,000	18134	67		
2,800,000	15296	63	4.18458	175	3,250,000	18201	67	4.26010	159
		62		173			67	4.26169	159
2,810,000	15359	63	4.18636	173	3,260,000	18268	68	4.26328	161
2,820,000	15421	63	4.18811	174	3,270,000	18335	67	4.26489	158
2,830,000	15484	62	4.18988	176	3,280,000	18403	68	4.26647	159
2,840,000	15546	63	4.19162	174	3,290,000	18470	67		
2,850,000	15609	63	4.19338	174	3,300,000	18538	68	4.26806	157
		63		175			68	4.26963	158
2,860,000	15672	63	4.19512	173	3,310,000	18605	68	4.27121	158
2,870,000	15735	63	4.19687	173	3,320,000	18673	68	4.27279	158
2,880,000	15798	63	4.19860	172	3,330,000	18741	68	4.27437	156
2,890,000	15861	63	4.20033	172	3,340,000	18809	68		
2,900,000	15924	63	4.20205	172	3,350,000	18877	68	4.27593	156
		63		173			68		
2,910,000	15987	64	4.20377	170	3,360,000	18945	69	4.27749	158
2,920,000	16051	63	4.20550	172	3,370,000	19014	68	4.27907	155
2,930,000	16114	64	4.20720	172	3,380,000	19082	69	4.28062	157
2,940,000	16178	64	4.20892	172	3,390,000	19151	68	4.28219	154
2,950,000	16242	64	4.21064		3,400,000	19219			

Table 6. Convergence—Continued

Northing	Function XV	Diff.	Log XV	Diff.	Northing	Function XV	Diff.	Log XV	Diff.
3,400,000	19219	68	4.28373	154					
3,410,000	19288	69	4.28529	156	3,860,000	22532	75	4.35280	145
3,420,000	19357	69	4.28684	155	3,870,000	22608	76	4.35426	146
3,430,000	19427	70	4.28841	157	3,880,000	22683	75	4.35570	144
3,440,000	19496	69	4.28995	154	3,890,000	22759	76	4.35715	145
3,450,000	19565	69	4.29148	153	3,900,000	22835	76	4.35860	145
3,460,000	19635	70	4.29303	155	3,910,000	22911	76	4.36004	144
3,470,000	19704	69	4.29455	152	3,920,000	22988	77	4.36150	146
3,480,000	19774	70	4.29609	154	3,930,000	23064	76	4.36293	143
3,490,000	19844	70	4.29763	154	3,940,000	23141	77	4.36438	145
3,500,000	19914	70	4.29916	153	3,950,000	23218	77	4.36582	144
3,510,000	19984	70	4.30068	152	3,960,000	23295	77	4.36726	144
3,520,000	20055	71	4.30222	154	3,970,000	23372	77	4.36870	144
3,530,000	20125	70	4.30374	152	3,980,000	23450	78	4.37014	144
3,540,000	20196	71	4.30527	153	3,990,000	23527	77	4.37157	143
3,550,000	20267	71	4.30679	152	4,000,000	23605	78	4.37300	143
3,560,000	20337	70	4.30829	150	4,010,000	23683	78	4.37444	144
3,570,000	20408	71	4.30980	151	4,020,000	23761	78	4.37586	142
3,580,000	20480	72	4.31133	153	4,030,000	23840	79	4.37731	145
3,590,000	20551	71	4.31283	150	4,040,000	23918	78	4.37872	141
3,600,000	20622	71	4.31433	150	4,050,000	23997	79	4.38016	144
3,610,000	20694	72	4.31584	151	4,060,000	24076	79	4.38158	142
3,620,000	20766	72	4.31735	151	4,070,000	24155	79	4.38301	143
3,630,000	20837	71	4.31884	149	4,080,000	24234	79	4.38443	142
3,640,000	20909	72	4.32033	149	4,090,000	24313	79	4.38584	141
3,650,000	20982	73	4.32185	152	4,100,000	24393	80	4.38727	143
3,660,000	21054	72	4.32333	148	4,110,000	24473	80	4.38869	142
3,670,000	21126	72	4.32482	149	4,120,000	24553	80	4.39010	141
3,680,000	21199	73	4.32632	150	4,130,000	24633	80	4.39152	142
3,690,000	21272	73	4.32781	149	4,140,000	24713	80	4.39293	141
3,700,000	21345	73	4.32930	149	4,150,000	24794	81	4.39435	142
3,710,000	21418	73	4.33078	148	4,160,000	24874	80	4.39575	140
3,720,000	21491	73	4.33226	148	4,170,000	24955	81	4.39716	141
3,730,000	21564	73	4.33373	147	4,180,000	25036	81	4.39856	140
3,740,000	21638	74	4.33522	149	4,190,000	25118	82	4.39999	143
3,750,000	21711	73	4.33668	146	4,200,000	25199	81	4.40138	139
3,760,000	21785	74	4.33816	148	4,210,000	25281	82	4.40279	141
3,770,000	21859	74	4.33963	147	4,220,000	25363	82	4.40420	141
3,780,000	21933	74	4.34110	147	4,230,000	25445	82	4.40560	140
3,790,000	22008	75	4.34258	148	4,240,000	25527	82	4.40700	140
3,800,000	22082	74	4.34404	146	4,250,000	25610	83	4.40841	141
3,810,000	22157	75	4.34551	147	4,260,000	25692	82	4.40980	139
3,820,000	22231	74	4.34696	145	4,270,000	25775	83	4.41120	140
3,830,000	22306	75	4.34842	146	4,280,000	25859	84	4.41261	141
3,840,000	22381	75	4.34988	146	4,290,000	25942	83	4.41400	139
3,850,000	22457	76	4.35135	147	4,300,000	26025	83	4.41539	139

Table 6. Convergence—Continued

Northing	Function XV	Diff.	Log XV	Diff.	Northing	Function XV	Diff.	Log XV	Diff.
4,300,000	26025	83	4.41539	139					
4,310,000	26109	84	4.41679	140	4,700,000	30117	94	4.47881	136
4,320,000	26193	84	4.41819	140	4,770,000	30212	95	4.48018	137
4,330,000	26277	84	4.41958	139	4,780,000	30307	95	4.48154	136
4,340,000	26362	85	4.42098	140	4,790,000	30403	96	4.48292	138
4,350,000	26446	84	4.42236	138	4,800,000	30498	95	4.48427	135
4,360,000					4,810,000	30504	96	4.48564	137
4,370,000	26531	85	4.42375	139	4,820,000	30601	97	4.48701	137
4,380,000	26616	86	4.42514	140	4,830,000	30787	96	4.48837	136
4,390,000	26702	85	4.42654	138	4,840,000	30884	97	4.48973	136
4,400,000	26787	86	4.42792	140	4,850,000	30981	97	4.49110	137
4,410,000	26873		4.42932		4,860,000	31079	98	4.49247	137
4,420,000	26959	86	4.43070	138	4,870,000	31177	98	4.49383	136
4,430,000	27045	86	4.43209	139	4,880,000	31275	98	4.49520	137
4,440,000	27131	87	4.43347	138	4,890,000	31373	98	4.49656	136
4,450,000	27218	87	4.43486	138	4,900,000	31472	99	4.49792	136
4,460,000	27305		4.43624		4,910,000	31570	98	4.49927	135
4,470,000	27392	87	4.43762	138	4,920,000	31670	100	4.50065	138
4,480,000	27479	88	4.43900	139	4,930,000	31769	99	4.50200	135
4,490,000	27567	87	4.44039	137	4,940,000	31869	100	4.50337	137
4,500,000	27654	88	4.44176	138	4,950,000	31969	100	4.50473	136
4,510,000	27742		4.44314		4,960,000	32070	101	4.50610	137
4,520,000	27831	89	4.44453	139	4,970,000	32170	100	4.50745	135
4,530,000	27919	88	4.44590	137	4,980,000	32272	102	4.50883	138
4,540,000	28008	89	4.44728	138	4,990,000	32373	101	4.51018	135
4,550,000	28097	89	4.44866	137	5,000,000	32475	102	4.51155	137
4,560,000	28186		4.45003		5,010,000	32577	102	4.51291	136
4,570,000	28275	89	4.45140	137	5,020,000	32679	102	4.51427	136
4,580,000	28365	90	4.45278	138	5,030,000	32782	103	4.51561	137
4,590,000	28455	90	4.45416	137	5,040,000	32885	103	4.51700	136
4,600,000	28545	90	4.45553	137	5,050,000	32988	103	4.51836	136
4,610,000	28635		4.45690		5,060,000	33092	104	4.51972	136
4,620,000	28726	91	4.45828	138	5,070,000	33196	104	4.52109	137
4,630,000	28817	91	4.45965	137	5,080,000	33300	104	4.52244	135
4,640,000	28908	92	4.46102	138	5,090,000	33405	105	4.52381	137
4,650,000	29000	91	4.46240	136	5,100,000	33510	105	4.52517	136
4,660,000	29091		4.46376		5,110,000	33615	105	4.52653	136
4,670,000	29183	92	4.46513	137	5,120,000	33721	106	4.52790	137
4,680,000	29276	93	4.46651	138	5,130,000	33827	106	4.52926	136
4,690,000	29368	92	4.46787	136	5,140,000	33933	106	4.53062	136
4,700,000	29461	93	4.46925	138	5,150,000	34040	107	4.53199	137
4,710,000	29554		4.47062		5,160,000	34147	107	4.53335	137
4,720,000	29647	93	4.47198	136	5,170,000	34251	107	4.53471	136
4,730,000	29740	93	4.47334	136	5,180,000	34362	108	4.53608	137
4,740,000	29834	94	4.47471	137	5,190,000	34470	108	4.53744	136
4,750,000	29928	95	4.47608	137	5,200,000	34579	109	4.53881	137
4,760,000	30023		4.47745						

Table 6. Convergence—Continued

Northing	Function XV	Diff.	Log XV	Diff.	Northing	Function XV	Diff.	Log XV	Diff.
5,200,000	34570	109	4.53881	137					
5,210,000	34688	109	4.54018	137	5,660,000	40006	128	4.60213	140
5,220,000	34797	110	4.54154	136	5,670,000	40134	128	4.60351	138
5,230,000	34907	110	4.54291	137	5,680,000	40263	129	4.60491	140
5,240,000	35017	110	4.54428	137	5,690,000	40393	130	4.60631	140
5,250,000	35127	110	4.54564	136	5,700,000	40523	130	4.60770	139
5,260,000	35238	111	4.54701	137	5,710,000	40653	130	4.60909	139
5,270,000	35349	111	4.54838	137	5,720,000	40784	131	4.61049	140
5,280,000	35461	111	4.54974	136	5,730,000	40916	132	4.61189	140
5,290,000	35572	112	4.55111	137	5,740,000	41048	132	4.61329	140
5,300,000	35684	112	4.55247	136	5,750,000	41181	133	4.61470	141
5,310,000	35797	113	4.55385	138	5,760,000	41314	133	4.61610	140
5,320,000	35910	113	4.55522	137	5,770,000	41447	133	4.61749	139
5,330,000	36023	113	4.55658	136	5,780,000	41582	135	4.61891	142
5,340,000	36137	114	4.55795	137	5,790,000	41716	134	4.62030	139
5,350,000	36252	115	4.55933	138	5,800,000	41852	136	4.62172	142
5,360,000	36366	114	4.56070	137	5,810,000	41988	136	4.62313	141
5,370,000	36481	115	4.56207	137	5,820,000	42124	136	4.62453	140
5,380,000	36597	116	4.56345	138	5,830,000	42261	137	4.62594	141
5,390,000	36712	115	4.56481	136	5,840,000	42398	137	4.62735	141
5,400,000	36829	117	4.56619	138	5,850,000	42537	139	4.62877	142
5,410,000	36945	116	4.56756	137	5,860,000	42675	138	4.63017	140
5,420,000	37062	117	4.56893	137	5,870,000	42814	139	4.63159	142
5,430,000	37180	118	4.57031	138	5,880,000	42954	140	4.63300	141
5,440,000	37298	118	4.57169	138	5,890,000	43095	141	4.63443	143
5,450,000	37416	118	4.57306	137	5,900,000	43236	141	4.63585	142
5,460,000	37535	119	4.57444	138	5,910,000	43377	141	4.63726	141
5,470,000	37654	119	4.57581	137	5,920,000	43519	142	4.63868	142
5,480,000	37774	120	4.57719	138	5,930,000	43662	143	4.64010	142
5,490,000	37894	120	4.57857	138	5,940,000	43805	143	4.64152	142
5,500,000	38015	121	4.57996	139	5,950,000	43950	145	4.64296	144
5,510,000	38136	121	4.58134	138	5,960,000	44094	144	4.64438	142
5,520,000	38257	121	4.58271	137	5,970,000	44239	145	4.64581	143
5,530,000	38379	122	4.58409	138	5,980,000	44385	146	4.64724	143
5,540,000	38501	122	4.58547	138	5,990,000	44532	147	4.64867	143
5,550,000	38624	123	4.58686	139	6,000,000	44679	147	4.65010	143
5,560,000	38747	123	4.58824	138	6,010,000	44826	147	4.65153	143
5,570,000	38871	124	4.58963	139	6,020,000	44975	149	4.65297	144
5,580,000	38995	124	4.59101	138	6,030,000	45124	149	4.65441	144
5,590,000	39120	125	4.59240	139	6,040,000	45274	150	4.65585	144
5,600,000	39245	125	4.59378	138	6,050,000	45424	150	4.65729	144
5,610,000	39370	125	4.59517	139	6,060,000	45575	151	4.65873	144
5,620,000	39496	126	4.59655	138	6,070,000	45727	152	4.66017	144
5,630,000	39623	127	4.59795	140	6,080,000	45879	152	4.66161	144
5,640,000	39750	127	4.59934	139	6,090,000	46032	153	4.66306	145
5,650,000	39878	128	4.60073	139	6,100,000	46186	154	4.66451	145

Table 6. Convergence—Continued

Northing	Function XV	Diff.	Log XV	Diff.	Northing	Function XV	Diff.	Log XV	Diff.
6,100,000	46186	154	4.66451	145					
6,110,000	46340	154	4.66596	145	6,560,000	54091	192	4.73313	155
6,120,000	46495	155	4.66741	145	6,570,000	54284	193	4.73467	154
6,130,000	46651	156	4.66886	145	6,580,000	54478	194	4.73622	155
6,140,000	46807	156	4.67031	145	6,590,000	54673	195	4.73777	155
6,150,000	46965	158	4.67177	146	6,600,000	54869	196	4.73933	156
6,160,000	47123	158	4.67323	146	6,610,000	55066	197	4.74088	155
6,170,000	47281	158	4.67469	146	6,620,000	55264	198	4.74244	156
6,180,000	47441	160	4.67615	146	6,630,000	55463	199	4.74400	156
6,190,000	47601	160	4.67762	147	6,640,000	55663	200	4.74557	157
6,200,000	47761	160	4.67907	145	6,650,000	55864	201	4.74713	156
6,210,000	47923	162	4.68054	147	6,660,000	56067	203	4.74871	158
6,220,000	48078	155	4.68195	141	6,670,000	56270	203	4.75028	157
6,230,000	48241	163	4.68342	147	6,680,000	56475	205	4.75186	158
6,240,000	48405	164	4.68489	147	6,690,000	56681	206	4.75344	158
6,250,000	48570	165	4.68637	148	6,700,000	56888	207	4.75502	158
6,260,000	48735	165	4.68784	147	6,710,000	57096	208	4.75661	159
6,270,000	48901	166	4.68932	148	6,720,000	57305	209	4.75819	158
6,280,000	49068	167	4.69080	148	6,730,000	57515	210	4.75978	159
6,290,000	49236	168	4.69228	148	6,740,000	57727	212	4.76138	160
6,300,000	49404	168	4.69376	148	6,750,000	57940	213	4.76298	160
6,310,000	49574	170	4.69525	149	6,760,000	58153	213	4.76457	159
6,320,000	49744	170	4.69674	149	6,770,000	58369	216	4.76618	161
6,330,000	49915	171	4.69823	149	6,780,000	58585	216	4.76779	161
6,340,000	50087	172	4.69973	150	6,790,000	58803	218	4.76940	161
6,350,000	50259	172	4.70121	148	6,800,000	59021	218	4.77101	161
6,360,000	50433	174	4.70271	150	6,810,000	59241	220	4.77262	161
6,370,000	50607	174	4.70421	150	6,820,000	59463	222	4.77425	163
6,380,000	50782	175	4.70571	150	6,830,000	59685	222	4.77587	162
6,390,000	50958	176	4.70721	150	6,840,000	59909	224	4.77749	162
6,400,000	51135	177	4.70872	151	6,850,000	60134	225	4.77912	163
6,410,000	51313	178	4.71023	151	6,860,000	60361	227	4.78076	164
6,420,000	51492	179	4.71174	151	6,870,000	60589	228	4.78239	163
6,430,000	51671	179	4.71325	151	6,880,000	60818	229	4.78403	164
6,440,000	51852	181	4.71477	152	6,890,000	61049	231	4.78568	165
6,450,000	52033	181	4.71628	151	6,900,000	61281	232	4.78733	165
6,460,000	52215	182	4.71780	152	6,910,000	61514	233	4.78897	164
6,470,000	52399	184	4.71932	152	6,920,000	61749	235	4.79063	166
6,480,000	52583	184	4.72085	153	6,930,000	61985	236	4.79229	166
6,490,000	52768	185	4.72237	152	6,940,000	62222	237	4.79394	165
6,500,000	52954	186	4.72390	153	6,950,000	62461	239	4.79561	167
6,510,000	53141	187	4.72543	153	6,960,000	62702	241	4.79728	167
6,520,000	53329	188	4.72696	153	6,970,000	62943	241	4.79895	167
6,530,000	53518	189	4.72850	151	6,980,000	63187	244	4.80063	168
6,540,000	53708	190	4.73004	154	6,990,000	63432	245	4.80231	168
6,550,000	53899	191	4.73158	154	7,000,000	63678	246	4.80399	168

Table 6. Convergence—Continued

Northing	Function XV	Diff.	Log XV	Diff.	Northing	Function XV	Diff.	Log XV	Diff.
7,000,000	63678	246	4.80399	168					
7,010,000	63926	248	4.80568	169	7,460,000	76953	336	4.88623	190
7,020,000	64175	249	4.80737	169	7,470,000	77292	339	4.88813	190
7,030,000	64426	251	4.80906	169	7,480,000	77633	341	4.89005	192
7,040,000	64679	253	4.81076	170	7,490,000	77977	344	4.89197	192
7,050,000	64933	254	4.81247	171	7,500,000	78324	347	4.89389	192
7,060,000	65189	256	4.81417	170	7,510,000	78673	349	4.89583	194
7,070,000	65446	257	4.81588	171	7,520,000	79025	352	4.89776	193
7,080,000	65705	259	4.81760	172	7,530,000	79380	355	4.89971	195
7,090,000	65966	261	4.81932	172	7,540,000	79737	357	4.90166	195
7,100,000	66228	262	4.82104	172	7,550,000	80097	360	4.90362	196
7,110,000	66492	264	4.82277	173	7,560,000	80460	363	4.90558	196
7,120,000	66758	266	4.82450	173	7,570,000	80826	366	4.90755	197
7,130,000	67025	267	4.82624	174	7,580,000	81195	369	4.90953	198
7,140,000	67295	270	4.82798	174	7,590,000	81566	371	4.91151	198
7,150,000	67566	271	4.82973	175	7,600,000	81941	375	4.91350	199
7,160,000	67838	272	4.83147	174	7,610,000	82318	377	4.91549	199
7,170,000	68113	275	4.83323	176	7,620,000	82699	381	4.91750	201
7,180,000	68389	276	4.83499	176	7,630,000	83082	383	4.91951	201
7,190,000	68667	278	4.83675	176	7,640,000	83469	387	4.92153	202
7,200,000	68947	280	4.83852	177	7,650,000	83859	390	4.92355	202
7,210,000	69229	282	4.84029	177	7,660,000	84252	393	4.92558	203
7,220,000	69513	284	4.84207	178	7,670,000	84648	396	4.92762	204
7,230,000	69799	286	4.84385	178	7,680,000	85048	400	4.92966	204
7,240,000	70087	288	4.84564	179	7,690,000	85450	402	4.93171	205
7,250,000	70376	289	4.84742	178	7,700,000	85857	407	4.93378	207
7,260,000	70668	292	4.84922	180	7,710,000	86266	409	4.93584	206
7,270,000	70962	294	4.85103	181	7,720,000	86679	413	4.93791	207
7,280,000	71257	295	4.85283	180	7,730,000	87096	417	4.94000	209
7,290,000	71555	298	4.85464	181	7,740,000	87516	420	4.94209	209
7,300,000	71855	300	4.85646	182	7,750,000	87939	423	4.94418	209
7,310,000	72157	302	4.85828	182	7,760,000	88367	428	4.94629	211
7,320,000	72461	304	4.86010	182	7,770,000	88797	430	4.94840	211
7,330,000	72767	306	4.86193	183	7,780,000	89232	435	4.95052	212
7,340,000	73075	308	4.86377	184	7,790,000	89670	438	4.95265	213
7,350,000	73386	311	4.86561	184	7,800,000	90113	443	4.95479	214
7,360,000	73698	312	4.86746	185	7,810,000	90559	446	4.95693	214
7,370,000	74013	315	4.86931	185	7,820,000	91009	450	4.95908	215
7,380,000	74330	317	4.87116	185	7,830,000	91463	454	4.96125	217
7,390,000	74650	320	4.87303	187	7,840,000	91921	458	4.96341	216
7,400,000	74972	322	4.87490	187	7,850,000	92383	462	4.96559	218
7,410,000	75296	324	4.87677	187	7,860,000	92849	466	4.96778	219
7,420,000	75623	327	4.87865	188	7,870,000	93320	471	4.96997	219
7,430,000	75952	329	4.88054	189	7,880,000	93795	475	4.97218	221
7,440,000	76283	331	4.88243	189	7,890,000	94274	479	4.97439	221
7,450,000	76617	334	4.88433	190	7,900,000	94758	484	4.97662	223

Table 6. Convergence—Continued

Northing	Easting XY	Dist.	Lat. XY	Dist.	Northing	Easting XY	Dist.	Lat. XY	Dist.
7,000,000	04783	484	4.07032	223					
7,010,000	05243	483	4.07035	223	8,360,000	123183	784	5.080445	2763
7,020,000	05733	482	4.08103	223	8,370,000	123043	780	5.083222	2777
7,030,000	06235	481	4.08333	225	8,380,000	124743	810	5.088016	2794
7,040,000	06737	480	4.08550	226	8,390,000	124543	810	5.088827	2811
7,050,000	07244	477	4.08783	227	8,400,000	123372	819	5.101651	2824
7,060,000	07755	476	4.08914	228	8,410,000	127202	830	5.104004	2843
7,070,000	08271	475	4.09043	229	8,420,000	128042	840	5.107352	2865
7,080,000	08792	474	4.09172	230	8,430,000	128883	851	5.110229	2877
7,090,000	09318	473	4.09303	231	8,440,000	129754	861	5.113121	2892
8,000,000	09840	472	4.09435	232	8,450,000	130625	872	5.116030	2909
8,010,000	10363	471	5.001673	2323	8,460,000	131510	884	5.118959	2929
8,020,000	10883	470	5.004012	2330	8,470,000	132404	894	5.121901	2942
8,030,000	10475	469	5.003360	2347	8,480,000	133310	903	5.124863	2952
8,040,000	10987	468	5.003715	2354	8,490,000	134225	916	5.127843	2960
8,050,000	10485	467	5.011094	2360	8,500,000	135153	920	5.130842	2970
8,060,000	10989	466	5.013465	2361	8,510,000	136101	943	5.133861	3019
8,070,000	103718	465	5.015854	2369	8,520,000	137055	954	5.136895	3034
8,080,000	104293	464	5.018255	2401	8,530,000	138023	968	5.139951	3053
8,090,000	104873	463	5.020664	2409	8,540,000	139003	980	5.143024	3073
8,100,000	105460	462	5.023085	2424	8,550,000	139997	994	5.146119	3095
8,110,000	106053	461	5.025523	2436	8,560,000	141005	1008	5.149235	3116
8,120,000	106651	460	5.027935	2442	8,570,000	142023	1021	5.152368	3133
8,130,000	107253	459	5.030422	2457	8,580,000	143052	1036	5.155524	3152
8,140,000	107858	458	5.032893	2471	8,590,000	144112	1050	5.158700	3176
8,150,000	108463	457	5.035374	2481	8,600,000	145176	1064	5.161895	3196
8,160,000	109110	456	5.037855	2491	8,610,000	146235	1080	5.165114	3219
8,170,000	109741	455	5.040336	2504	8,620,000	147351	1095	5.168353	3239
8,180,000	110379	454	5.042856	2517	8,630,000	148462	1111	5.171615	3262
8,190,000	111023	453	5.045413	2527	8,640,000	149560	1128	5.174903	3289
8,200,000	111675	452	5.047936	2543	8,650,000	150733	1143	5.178208	3305
8,210,000	112333	451	5.050507	2551	8,660,000	151894	1161	5.181541	3333
8,220,000	112999	450	5.053075	2569	8,670,000	153071	1177	5.184893	3352
8,230,000	113672	449	5.055654	2579	8,680,000	154267	1196	5.188273	3380
8,240,000	114353	448	5.058248	2594	8,690,000	155480	1213	5.191675	3402
8,250,000	115041	447	5.060853	2605	8,700,000	156712	1232	5.195102	3427
8,260,000	115737	446	5.063472	2619	8,710,000	157962	1250	5.198553	3451
8,270,000	116441	445	5.066106	2634	8,720,000	159232	1270	5.202030	3477
8,280,000	117153	444	5.068753	2647	8,730,000	160522	1290	5.205535	3505
8,290,000	117873	443	5.071414	2661	8,740,000	161831	1309	5.209062	3527
8,300,000	118601	442	5.074088	2674	8,750,000	163162	1331	5.212619	3557
8,310,000	119338	441	5.076779	2691	8,760,000	164514	1352	5.216203	3584
8,320,000	120083	440	5.079482	2703	8,770,000	165887	1373	5.219812	3609
8,330,000	120837	439	5.082200	2718	8,780,000	167283	1396	5.223452	3640
8,340,000	121600	438	5.084934	2734	8,790,000	168702	1419	5.227120	3668
8,350,000	122371	437	5.087679	2745	8,800,000	170144	1442	5.230817	3697

Table 6. Convergence—Continued

Northing	Function XV	Diff.	Log XV	Diff.	Northing	Function XV	Diff.	Log XV	Diff.
8,800,000	170144	1442	5.230817	3607					
8,810,000	171610	1406	5.234843	3726	8,860,000	179322	1500	5.253034	3883
8,820,000	173100	1490	5.238297	3754	8,870,000	180945	1023	5.257547	3013
8,830,000	174616	1516	5.242084	3787	8,880,000	182597	1652	5.261404	3047
8,840,000	176158	1542	5.245902	3818	8,890,000	184270	1082	5.265470	3982
8,850,000	177728	1568	5.249751	3849	8,900,000	185901	1712	5.269492	4016

Table 6a. Grid Convergence Nomograph

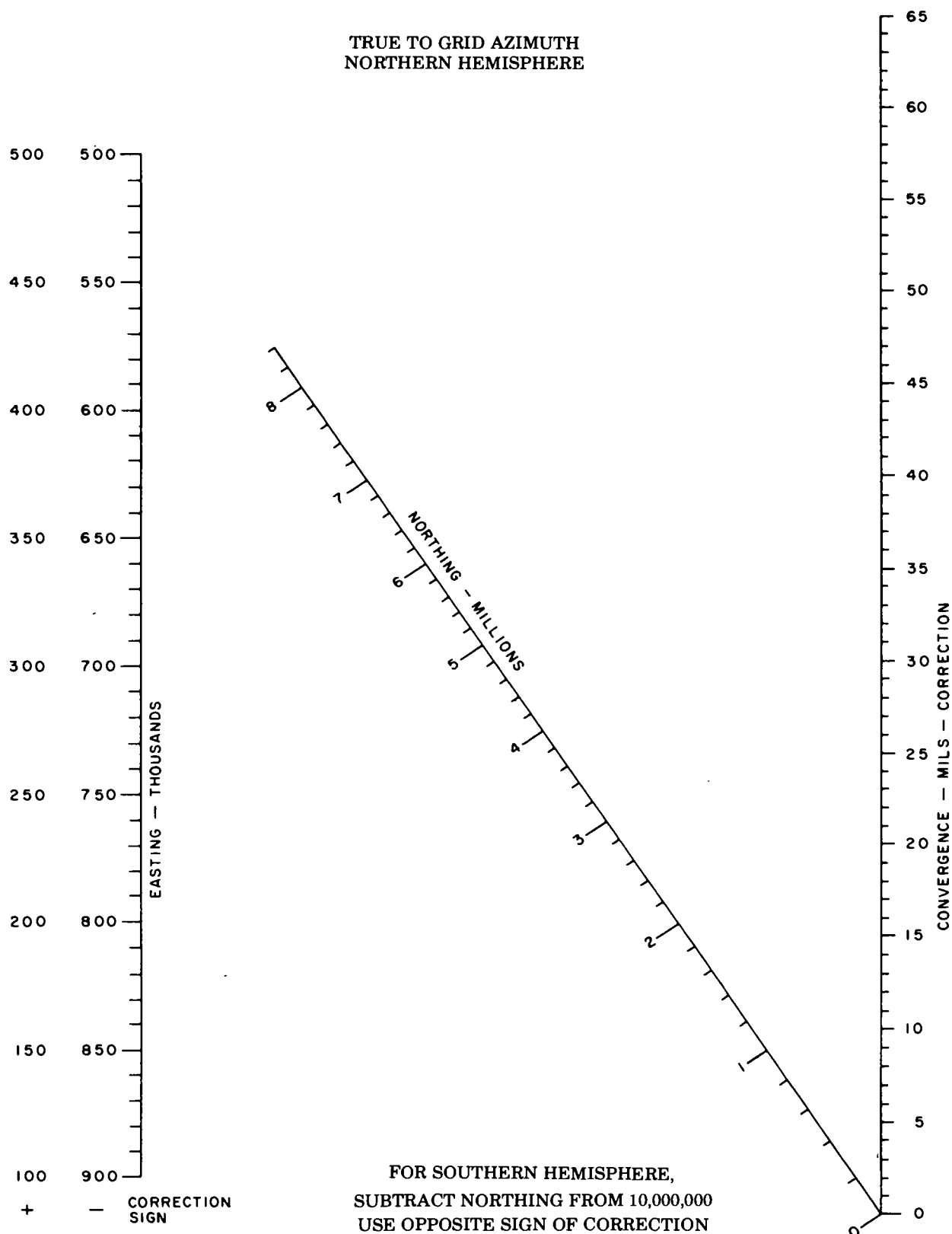
TRUE TO GRID AZIMUTH
NORTHERN HEMISPHERE

Table 7. Second Term in Convergence Computation, UTM Coordinates

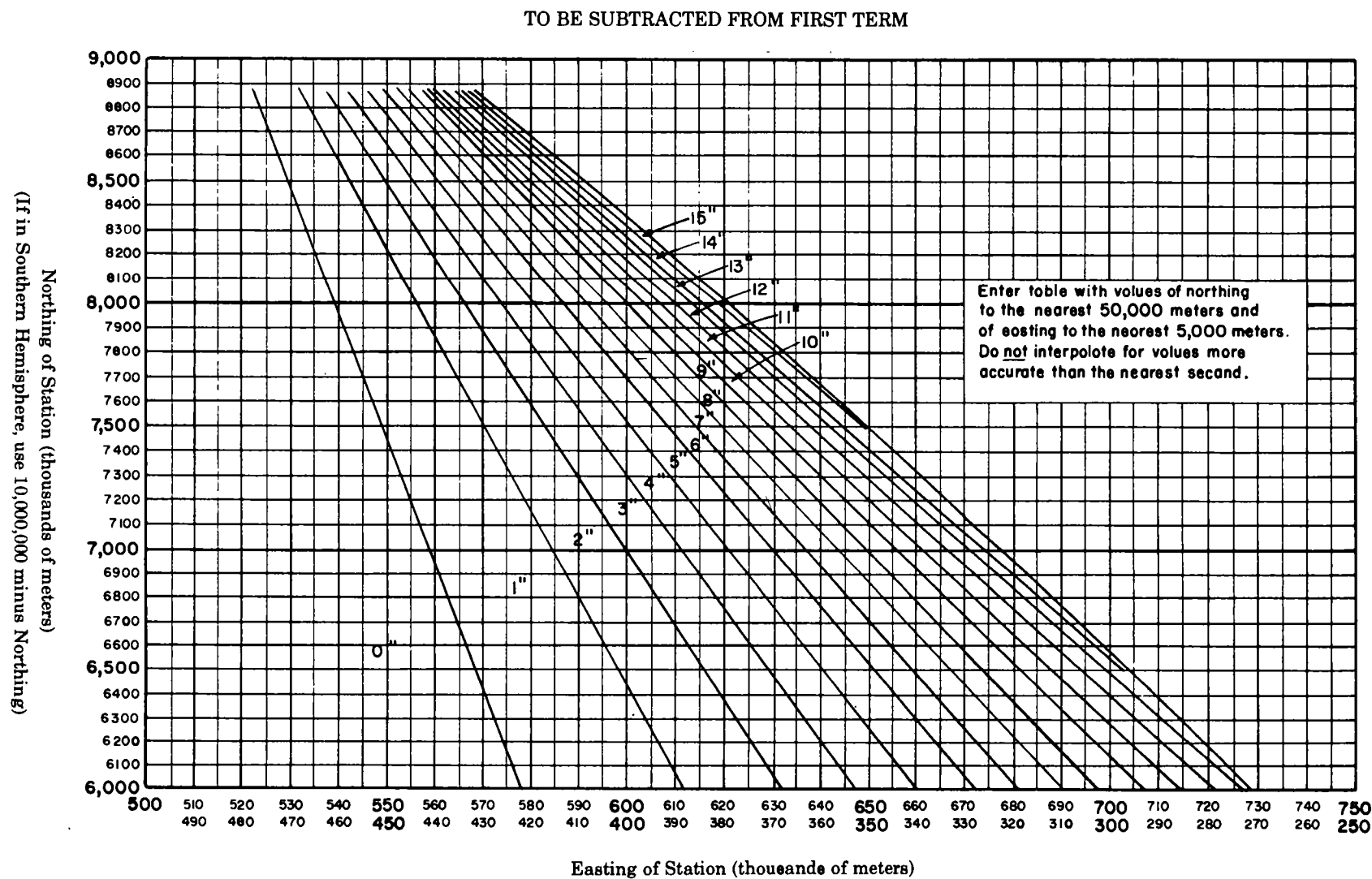


Table 7. Second Term in Convergence Computation, UTM Coordinates—Continued

CONVERSION TABLE	
1"	0.00 m
2"	0.01 m
3"	0.01 m
4"	0.02 m
5"	0.02 m
6"	0.03 m
7"	0.03 m
8"	0.04 m
9"	0.04 m
10"	0.05 m
11"	0.05 m
12"	0.06 m
13"	0.06 m
14"	0.07 m
15"	0.07 m

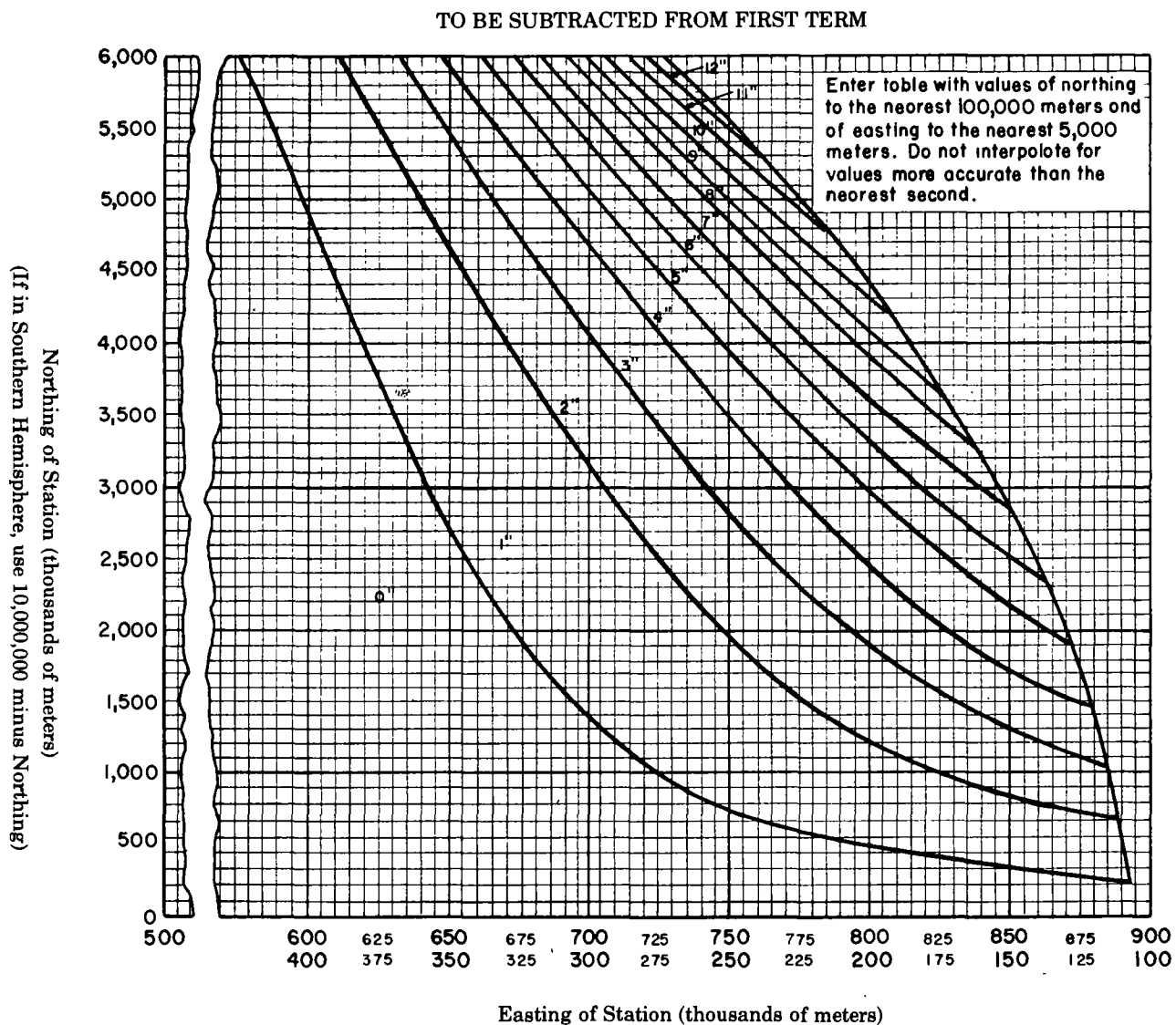


Table 8a. Second Term in Convergence Computation, Geographic Coordinates (Degrees)

TO BE ADDED TO FIRST TERM

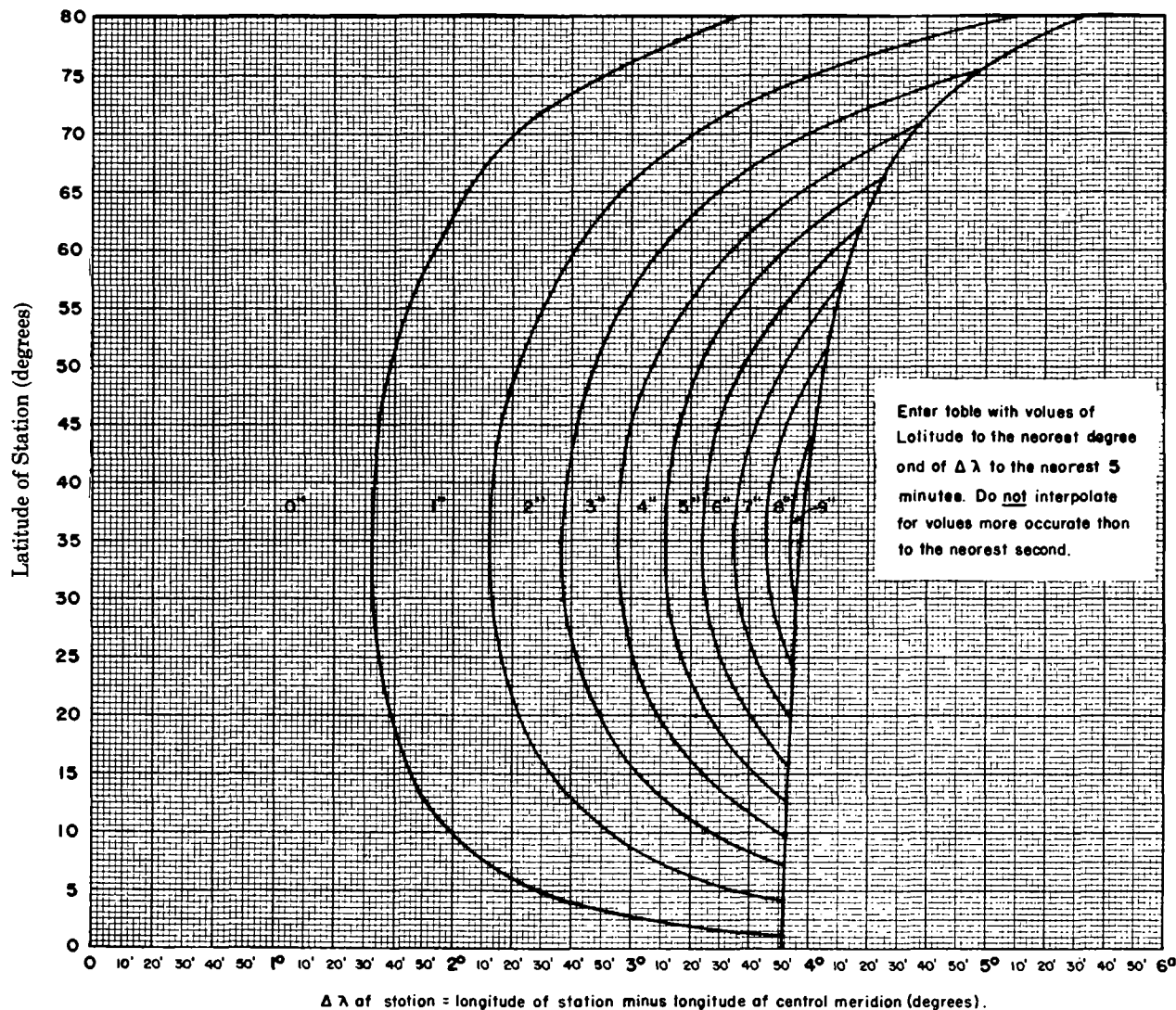


Table 8b. Second Term in Convergence Computation, Geographic Coordinates (Mils)

TO BE ADDED TO FIRST TERM

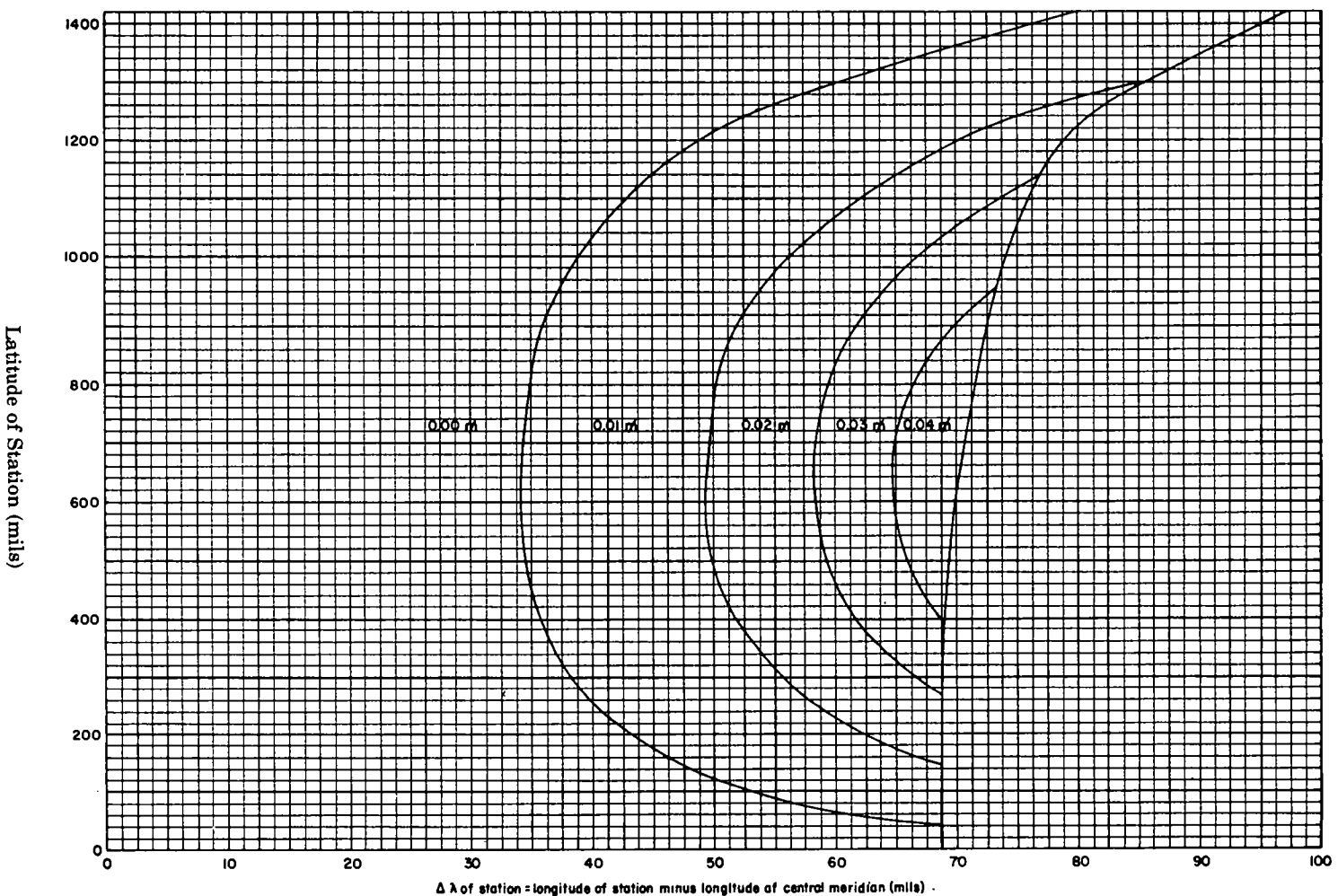


Table 9. Alphabetical Star List

Enter table with name of star to obtain the number for use in entering table 10a, 10b, or 11.

Star	Constellation	No.	Magnitude
Acamar, Theta (θ) Eridani	Eridanus	12	3.4
Achernar, Alpha (α) Eridani	Eridanus	9	0.6
Acrux, Alpha (α) Crucis	Crux	42	1.0
Adhara, Epsilon (ϵ) Canis Majoris	Canis Major	26	1.6
Aldebaran, Alpha (α) Tauri	Taurus	15	1.1
Alhena, Gamma (γ) Geminorum*	Gemini	24	1.9
Alioth, Epsilon (ϵ) Ursae Majoris	Ursa Major	45	1.7
Alkaid, (Benetnasch), Eta (η) Ursae Majoris	Ursa Major	48	1.9
Al Na'ir, Alpha (α) Gruis	Gruis	71	2.2
Alnilam, Epsilon (ϵ) Orionis	Orion	20	1.7
Alnitak, Zeta (ζ) Orionis*	Orion	21	2.0
Alpha (α) Ceti, Menkar**	Cetus	13	2.8
Alpha (α) Persei, Mirfak	Perseus	14	1.9
Alpha (α) Tri Aust, Atria	Triangulum Australe	58	1.9
Alphard, Alpha (α) Hydrae	Hydra	35	2.2
Alphecca, Alpha (α) Coronae Bor.	Corona Borealis	55	2.3
Alpheratz, Alpha (α) Andromedae	Andromeda	1	2.1
(Al Suhail), Suhail, Lambda (λ) Velorum	Vela (Argo)	33	2.2
Altair, Alpha (α) Aquilae	Aquila	66	0.9
Ankaa, Alpha (α) Phoenix**	Phoenix	4	2.4
Antares, Alpha (α) Scorpii	Scorpius	57	1.2
Arcturus, Alpha (α) Bootis	Bootes	51	0.2
Atria, Alpha (α) Tri Aust	Triangulum Australe	58	1.9
Avior, Epsilon (ϵ) Carinae	Carina (Argo, Vela)	32	1.7
Bellatrix, Gamma (γ) Orionis	Orion	18	1.7
Beta (β) Centauri, Hadar	Centaurus	49	0.9
Beta (β) Crucis, Mimosa*	Crux	44	1.5
Beta (β) Hydri***	Hydra	3	2.9
Betelgeuse, (Betelgeux), Alpha (α) Orionis	Orion	22	0.1
Canopus, Alpha (α) Carinae	Carina (Argo, Vela)	23	-0.6
Capella, Alpha (α) Aurigae	Auriga	17	0.2
Caph, Beta (β) Cassiopeiae*	Cassiopeia	2	2.4
Castor, Alpha (α) Geminorum*	Gemini	28	1.6
Delta (δ) Canis Majoris, Wezen*	Canis Major	27	2.0
Deneb, Alpha (α) Cygni	Cygnus	68	1.3
Denebola, Beta (β) Leonis	Leo	39	2.2
Diphda, (Deneb Kaitos), Beta (β) Ceti	Cetus	6	2.2
Dschubba, Delta (δ) Scorpii**	Scorpius	56	2.5
Dubhe, Alpha (α) Ursae Majoris	Ursa Major	38	1.9
Elnath, (El Nath), Beta (β) Tauri	Taurus	19	1.8
Eltanin, (Eltamin), Gamma (γ) Draconis	Draco	62	2.4
Enif, Epsilon (ϵ) Pegasi	Pegasus	70	2.5
Epsilon (ϵ) Carinae, Avior	Carina (Argo, Vela)	32	1.7
Fomalhaut, Alpha (α) Piscis Austrini	Piscis Austrinus	72	1.3
Gacrux, Gamma (γ) Crucis	Crux	43	1.6
Gamma (γ) Cassiopeiae*	Cassiopeia	7	1.6-2.8
Gamma (γ) Velorum, (Gamma Argus)*	Vela (Argo)	31	1.9
Gamma (γ) Geminorum, Alhena*	Gemini	24	1.9
Gienah, Gamma (γ) Corvi**	Corvus	41	2.8
Hadar, Beta (β) Centauri	Centaurus	49	0.9
Hamal, Alpha (α) Arietis	Aries	11	2.2
Kaus Australis, Epsilon (ϵ) Sagittarii	Sagitta	63	1.9
Kochab, Beta (β) Ursae Minoris	Ursa Minor	54	2.2
Markab, Alpha (α) Pegasi	Pegasus	73	2.0
Menkar, Alpha (α) Ceti**	Cetus	13	2.8
Menkent, Theta (θ) Centauri	Centaurus	50	2.3
Merak, Beta (β) Ursae Majoris*	Ursa Major	37	2.4

Table 9. Alphabetical Star List—Continued

Star	Constellation	No.	Magnitude
Miaplacidus, Beta (β) Carinae.....	Carina (Argo).....	34	1.8
Mimosa, Beta (β) Crucis*.....	Crux.....	44	1.5
Mirfak, (Marfak), Alpha (α) Persei.....	Perseus.....	14	1.9
Mizar, Zeta (ζ) Ursae Majoris*.....	Ursa Major.....	46	2.4
Nunki, Sigma (σ) Sagittarii.....	Sagitta.....	65	2.1
(Octantis), Nu (ν) Octantis***.....	Octans.....	69	3.7
Peacock, Alpha (α) Pavonis.....	Pavo.....	67	2.1
Phceda, Gamma (γ) Ursae Majoris*.....	Ursa Major.....	40	2.5
Polaris, Alpha (α) Ursae Minoris***.....	Ursa Minor.....	10	2.1
Pollux, Beta (β) Geminorum.....	Gemini.....	30	1.2
Procyon, Alpha (α) Canis Minoris.....	Canis Minor.....	29	0.5
Rasalhague, Alpha (α) Ophiuchi.....	Ophiuchus.....	61	2.1
Regulus, Alpha (α) Leonis.....	Leo.....	36	1.3
Rigel, Beta (β) Orionis.....	Orion.....	16	0.3
Rigel Kentaurus, Alpha (α) Centauri.....	Centaurus.....	52	0.1
Ruchbah, Delta (δ) Cassiopeiae*.....	Cassiopeia.....	8	2.8
Sabik, Eta (η) Ophiuchi.....	Ophiuchus.....	59	2.6
Scaula, (Shaula), Lambda (λ) Scorpii.....	Scorpius.....	60	1.7
Schedar, (Schedir), Alpha (α) Cassiopeiae.....	Cassiopeia.....	5	2.3
Sirius, Alpha (α) Canis Majoris.....	Canis Major.....	25	-1.6
Spica, Alpha (α) Virginis.....	Virgo.....	47	1.2
Suhail, (Al Suhail), Lambda (λ) Velorum.....	Vela (Argo).....	33	2.2
Theta (θ) Centauri, Menkent.....	Centaurus.....	50	2.3
Vega, Alpha (α) Lyrae.....	Lyra.....	64	0.1
Wezen, Delta (δ) Canis Majoris*.....	Canis Major.....	27	2.0
Zeta (ζ) Orionis, Alnitak*.....	Orion.....	21	2.0
Zebenelgenubi, Alpha (α) Librae**.....	Libra.....	53	2.9

Note. Sirius (magnitude—1.6) is the brightest star listed, Octantis (magnitude 3.7) is the dimmest star listed. Brightness of other stars listed is indicated by their magnitude.

Spelled out names in parentheses are names sometimes used but not recommended.

- * Indicates star not on identifier 2012D.
- ** Indicates star not on identifier 2012C.
- *** Indicates star not on either identifier.

The constellation Argus has been replaced by its three modern divisions Carina, Puppis, and Vela.

Table 10a. Apparent Places of Stars, 1979 (Degrees)

STAR NO.	Right ascension Declination (Hr Min ° ' ")		Zero hours universal time (GMT) of first day of month												
			JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
	Seconds (time of RA or arc of declination)														
1	RA DEC	0 7 28 58	17.9 36	17.5 32	17.2 27	17.3 23	17.8 21	18.6 22	19.6 27	20.6 34	21.2 42	21.5 48	21.4 53	21.1 55	20.6 54
2	RA DEC	0 8 59 1	3.5 78	2.5 74	1.9 67	1.9 58	2.7 52	4.0 50	5.5 53	6.9 60	7.8 70	8.1 80	7.9 89	7.2 95	6.3 96
3	RA DEC	0 24 -77 21	36.9 103	34.4 98	32.9 90	32.5 79	33.5 67	35.9 58	39.0 54	42.2 54	44.6 60	45.5 69	44.8 78	42.8 84	40.0 85
4	RA DEC	0 25 -42 24	14.1 89	13.5 87	13.2 83	13.2 75	13.6 66	14.5 57	15.6 51	16.7 48	17.5 50	17.9 56	17.8 63	17.4 69	16.8 71
5	RA DEC	0 39 56 25	19.2 35	18.3 32	17.6 26	17.5 18	18.0 11	19.1 9	20.5 11	21.9 17	23.0 26	23.5 35	23.4 44	23.0 50	22.1 52
5	RA DEC	0 42 -18 5	31.8 76	31.4 77	31.1 76	31.1 72	31.4 66	32.1 59	33.0 53	34.0 48	34.7 46	35.1 48	35.1 52	34.9 56	34.5 59
7	RA DEC	0 55 60 35	26.9 86	25.8 84	25.0 78	24.7 70	25.2 63	26.4 59	27.9 60	29.5 66	30.7 74	31.4 84	31.4 94	30.9 101	30.0 104
8	RA DEC	1 24 60 7	27.2 49	26.1 47	25.2 42	24.8 35	25.1 28	26.2 23	27.7 23	29.3 28	30.6 36	31.5 45	31.7 54	31.4 61	30.6 65
9	RA DEC	1 36 -57 20	55.7 57	54.7 57	53.9 52	53.3 44	53.4 33	54.1 22	55.4 15	56.8 11	58.1 13	58.9 19	59.1 28	58.6 36	57.8 41

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See Table 11. Apparent Places of Polaris, 1979

11	RA DEC	2 5 23 21	59.8 50	59.3 48	58.9 46	58.6 43	58.7 41	59.2 42	60.1 45	61.1 50	62.0 55	62.6 60	62.9 63	63.0 65	62.8 65
12	RA DEC	2 57 -40 22	28.4 97	27.7 101	27.1 100	26.5 94	26.3 86	26.6 76	27.3 67	28.3 61	29.4 59	30.2 62	30.7 69	30.8 77	30.4 84
13	RA DEC	3 1 4 0	11.5 21	11.1 19	10.6 18	10.2 18	10.2 20	10.5 23	11.2 28	12.1 33	13.0 37	13.7 39	14.1 39	14.3 37	14.2 35
14	RA DEC	3 22 49 47	50.6 18	50.0 20	49.2 19	48.5 15	48.3 9	48.7 5	49.6 3	50.9 3	52.2 7	53.3 12	54.1 19	54.5 25	54.4 30
15	RA DEC	4 34 16 27	43.9 58	43.7 57	43.2 56	42.7 55	42.4 55	42.5 56	43.0 58	43.8 61	44.7 63	45.6 65	46.3 66	46.8 65	47.0 65
16	RA DEC	5 13 -8 13	32.8 42	32.6 46	32.1 48	31.6 48	31.2 46	31.1 41	31.4 35	32.1 30	32.9 26	33.8 25	34.5 27	35.1 32	35.3 38
17	RA DEC	5 15 45 58	9.9 36	9.6 40	9.0 42	8.2 41	7.7 37	7.6 33	8.1 30	9.0 27	10.2 27	11.5 28	12.6 31	13.4 35	13.8 40
18	RA DEC	5 23 6 19	61.4 44	61.2 42	60.8 40	60.2 40	59.9 41	59.8 44	60.1 47	60.8 50	61.6 53	62.5 54	63.3 53	63.9 50	64.2 47
19	RA DEC	5 24 28 35	59.1 19	59.0 21	58.5 21	57.9 21	57.5 20	57.4 18	57.8 18	58.5 18	59.5 19	60.5 20	61.4 21	62.1 22	62.5 23

Table 10a. Apparent Places of Stars, 1979 (Degrees)—Continued

STAR NO.	Right ascension (Hr Min) Declination (° ')		Zero hours universal time (GMT) of first day of month												
			JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
			Seconds (time of RA or arc of declination)												
20	RA DEC	5 35 -1 12	10.3 63	9.9 66	9.5 68	8.9 68	8.5 67	8.4 63	8.7 59	9.3 54	10.1 51	10.9 50	11.7 52	12.3 56	12.7 60
21	RA DEC	5 39 -1 57	43.1 21	43.0 25	42.6 26	42.0 27	41.6 25	41.5 21	41.8 17	42.3 12	43.2 9	44.0 8	44.8 10	45.4 14	45.8 19
22	RA DEC	5 54 7 24	3.2 5	3.2 3	2.8 1	2.2 1	1.8 2	1.7 4	1.9 7	2.5 10	3.3 13	4.2 13	5.0 12	5.7 9	6.1 6
23	RA DEC	6 23 -52 40	31.4 73	31.1 83	30.3 88	29.2 90	28.2 87	27.6 80	27.5 70	28.0 60	28.9 53	30.1 51	31.3 54	32.2 63	32.6 74
24	RA DEC	6 36 16 24	31.1 55	31.2 54	30.9 54	30.4 55	29.9 55	29.7 56	29.8 57	30.3 58	31.1 59	31.9 59	32.9 57	33.7 55	34.2 53
25	RA DEC	6 44 -16 41	14.5 24	14.6 31	14.2 34	13.6 36	13.1 34	12.8 29	12.8 23	13.2 17	13.9 12	14.8 11	15.6 14	16.4 20	16.9 28
26	RA DEC	6 57 -28 56	49.5 43	49.5 52	49.2 57	48.5 59	47.9 57	47.5 52	47.4 45	47.8 37	48.4 31	49.3 28	50.2 31	51.1 38	51.6 47
27	RA DEC	7 7 -26 21	33.7 42	33.7 50	33.4 55	32.8 57	32.2 56	31.8 51	31.7 44	32.0 37	32.7 31	33.5 28	34.4 31	35.3 37	35.8 46
28	RA DEC	7 33 31 55	16.8 56	17.1 58	16.9 60	16.3 62	15.7 63	15.4 62	15.3 61	15.7 58	16.4 56	17.3 53	18.4 51	19.4 50	20.2 50
29	RA DEC	7 38 5 16	13.4 36	13.6 32	13.4 31	12.9 31	12.4 31	12.1 33	12.1 36	12.4 38	13.0 40	13.7 39	14.6 37	15.5 33	16.1 28
30	RA DEC	7 44 28 4	3.1 28	3.4 30	3.2 31	2.7 33	2.1 34	1.8 34	1.7 33	2.0 31	2.7 29	3.5 27	4.6 24	5.5 22	6.3 21
31	RA DEC	8 8 -47 16	55.2 30	55.5 41	55.1 49	54.4 54	53.5 55	52.7 52	52.3 45	52.4 35	52.9 27	53.8 22	54.9 23	56.0 28	56.8 39
32	RA DEC	8 22 -59 26	8.0 30	8.3 41	7.8 51	6.8 57	5.6 59	4.5 56	3.8 49	3.6 40	4.1 31	5.2 25	6.6 24	8.0 29	9.1 39
33	RA DEC	9 7 -43 20	15.2 49	15.7 59	15.6 68	15.1 75	14.4 77	13.6 75	13.2 70	13.0 62	13.3 54	13.9 48	15.0 47	16.1 52	17.1 61
34	RA DEC	9 12 -69 37	62.9 44	63.6 56	63.3 66	62.0 75	60.3 79	58.5 79	57.1 74	56.4 65	56.6 55	57.8 48	59.6 45	61.7 48	63.4 57
35	RA DEC	9 26 -8 34	34.2 6	34.8 12	34.9 17	34.6 19	34.2 19	33.8 17	33.5 14	33.5 10	33.7 7	34.2 6	35.0 7	35.9 12	36.8 19
36	RA DEC	10 7 12 3	15.8 65	16.5 61	16.8 60	16.6 61	16.3 63	15.8 65	15.6 67	15.4 67	15.6 67	16.0 64	16.8 60	17.7 55	18.7 49
37	RA DEC	11 0 56 29	34.8 25	36.1 27	36.8 32	36.7 40	36.1 47	35.3 50	34.5 49	33.9 44	33.8 37	34.2 27	35.2 18	36.5 11	38.1 8

Table 10a., Apparent Places of Stars, 1979 (Degrees)—Continued

STAR NO.	Right ascension (Hr Min) Declination (° ')		Zero hours universal time (GMT) of first day of month											
			JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
			Seconds (time of RA or arc of declination)											
38	RA	11 2	26.4	27.9	28.6	28.5	27.8	26.7	25.8	25.1	24.9	25.3	26.4	27.9
	DEC	61 51	34	36	42	51	57	61	60	54	46	36	26	19
39	RA	11 47	59.3	60.2	60.7	60.9	60.7	60.4	60.1	59.8	59.6	59.7	60.2	61.0
	DEC	14 40	76	72	70	72	75	78	80	81	80	76	71	65
40	RA	11 52	43.3	44.6	45.4	45.6	45.3	44.6	43.9	43.2	42.8	42.9	43.6	44.7
	DEC	53 48	25	25	29	37	44	49	50	47	40	31	21	13
41	RA	12 14	43.6	44.5	45.1	45.3	45.3	45.0	44.7	44.3	44.1	44.1	44.5	45.3
	DEC	-17 25	25	32	38	42	45	45	44	41	37	35	34	37
42	RA	12 25	26.5	28.1	29.1	29.6	29.4	28.7	27.6	26.5	25.7	25.5	26.1	27.5
	DEC	-62 58	38	45	54	65	74	80	82	79	73	65	57	54
43	RA	12 30	0.4	1.9	2.8	3.2	3.1	2.5	1.7	0.9	0.2	0.0	0.5	1.7
	DEC	-56 59	26	33	42	52	61	66	68	65	59	51	44	42
44	RA	12 46	29.8	31.4	32.4	33.0	33.0	32.5	31.6	30.6	29.8	29.6	30.0	31.2
	DEC	-59 34	7	13	22	32	41	47	50	47	42	34	27	23
45	RA	12 53	5.3	6.8	7.8	8.3	8.2	7.6	6.8	6.0	5.3	5.0	5.4	6.2
	DEC	56 3	70	68	71	79	87	94	97	96	90	81	70	60
46	RA	13 23	3.4	4.9	6.0	6.7	6.7	6.3	5.5	4.6	3.9	3.5	3.6	4.3
	DEC	55 1	52	49	51	58	66	74	78	78	73	64	54	43
47	RA	13 24	4.7	5.7	6.4	6.9	7.0	7.0	6.7	6.3	5.9	5.8	5.9	6.5
	DEC	-11 3	1	7	12	15	16	16	14	12	10	9	9	12
48	RA	13 46	41.4	42.7	43.7	44.4	44.6	44.3	43.7	43.0	42.3	41.8	41.8	42.4
	DEC	49 24	53	49	50	56	64	72	76	77	74	66	56	46
49	RA	14 2	19.5	21.2	22.6	23.6	24.1	24.0	23.4	22.4	21.4	20.8	20.8	21.6
	DEC	-60 15	59	62	69	77	86	94	98	99	95	89	82	76
50	RA	14 5	26.1	27.2	28.1	28.8	29.1	29.2	28.9	28.4	27.8	27.5	27.5	28.1
	DEC	-36 15	46	51	57	63	69	73	75	74	71	67	63	61
51	RA	14 14	41.2	42.2	43.0	43.6	43.9	43.9	43.6	43.2	42.7	42.4	42.4	42.8
	DEC	19 17	27	21	19	20	24	29	33	35	35	32	26	18
52	RA	14 38	9.9	11.6	13.0	14.2	14.8	14.8	14.3	13.3	12.2	11.4	11.2	11.9
	DEC	-60 44	28	30	35	43	51	59	64	66	63	57	50	44
53	RA	14 49	42.0	43.0	43.8	44.5	45.0	45.1	45.0	44.6	44.2	43.8	43.7	44.1
	DEC	-15 57	9	13	18	21	22	23	22	21	19	18	17	19
54	RA	14 50	40.6	43.1	45.5	47.5	48.2	47.7	46.2	44.0	41.6	39.8	38.7	39.0
	DEC	74 14	19	14	14	21	30	39	46	48	45	38	27	16
55	RA	15 33	46.5	47.4	48.3	49.1	49.6	49.8	49.7	49.3	48.7	48.2	47.9	48.1
	DEC	26 46	65	58	55	57	62	69	75	79	80	77	71	63

Table 10a. Apparent Places of Stars, 1979 (Degrees)—Continued

STAR NO.	Right ascension (Hr Min) Declination (° ')		Zero hours universal time (GMT) of first day of month												
			JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
			Seconds (time of RA or arc of declination)												
56	RA DEC	15 59 -22 33	4.1 34	5.1 37	6.0 40	6.9 43	7.5 45	7.9 46	8.0 46	7.7 46	7.2 45	6.7 44	6.4 43	6.6 42	7.2 44
57	RA DEC	16 28 -26 22	5.7 59	6.6 61	7.5 63	8.5 65	9.2 67	9.7 69	9.9 70	9.6 70	9.1 70	8.6 69	8.2 67	8.3 66	8.9 67
58	RA DEC	16 46 -68 59	22.6 10	24.6 6	26.7 6	28.9 8	30.8 14	31.9 22	32.2 30	31.4 36	30.0 39	28.5 37	27.3 31	27.1 24	28.2 17
59	RA DEC	17 9 -15 41	8.8 50	9.6 53	10.5 55	11.4 56	12.1 56	12.7 55	13.0 54	12.9 53	12.4 53	11.9 52	11.5 52	11.4 53	11.9 55
60	RA DEC	17 32 -37 5	9.1 11	9.9 10	10.9 10	12.0 11	13.0 12	13.7 15	14.1 17	14.0 20	13.6 21	12.9 21	12.3 20	12.2 17	12.6 14
61	RA DEC	17 33 12 34	56.3 35	56.6 28	57.4 25	58.3 24	59.1 27	59.6 33	59.9 38	59.8 43	59.4 46	58.8 46	58.3 43	58.2 38	58.5 32
62	RA DEC	17 56 51 29	4.7 33	5.4 23	6.4 17	7.6 16	8.7 21	9.4 30	9.7 40	9.3 48	8.5 54	7.5 55	6.5 51	5.9 43	6.0 32
63	RA DEC	18 22 -34 23	44.8 36	45.5 34	46.3 33	47.4 33	48.4 32	49.3 33	49.8 35	49.9 37	49.5 39	48.9 40	48.3 40	48.1 38	48.3 36
64	RA DEC	18 36 38 45	11.8 56	12.3 47	13.0 41	14.0 39	15.0 43	15.8 50	16.2 60	16.1 68	15.6 74	14.9 76	14.1 74	13.6 68	13.6 59
65	RA DEC	18 53 -26 19	56.0 19	56.5 18	57.3 18	58.2 16	59.2 15	60.1 14	60.7 14	60.8 15	60.6 16	60.1 17	59.5 17	59.2 17	59.3 16
66	RA DEC	19 49 8 48	44.1 51	44.3 46	44.8 42	45.6 42	46.5 44	47.3 49	47.9 55	48.2 61	48.1 65	47.7 67	47.1 66	46.7 63	46.6 59
67	RA DEC	20 23 -56 47	56.6 74	56.9 67	57.7 61	58.9 55	60.4 51	61.9 50	63.1 52	63.8 58	63.7 64	63.1 69	62.1 72	61.2 70	60.9 65
68	RA DEC	20 40 45 12	41.5 31	41.5 21	41.8 14	42.7 8	43.7 9	44.9 14	45.7 23	46.1 33	45.9 42	45.4 48	44.5 50	43.8 48	43.3 41
69	RA DEC	21 39 -77 28	4.6 74	3.9 65	4.6 55	6.6 45	9.6 39	13.2 36	16.3 38	18.4 44	19.0 53	17.9 61	15.4 66	12.7 66	10.6 61
70	RA DEC	21 43 9 46	8.2 47	8.1 43	8.3 40	8.8 39	9.6 41	10.5 46	11.4 52	11.9 58	12.1 63	12.0 66	11.6 66	11.1 65	10.8 62
71	RA DEC	22 6 -47 3	52.9 57	52.7 52	52.9 46	53.5 38	54.5 31	55.8 26	57.0 24	57.9 26	58.3 31	58.1 36	57.5 42	56.8 44	56.3 42
72	RA DEC	22 56 -29 43	28.4 71	28.1 69	28.1 65	28.5 59	29.2 53	30.1 46	31.2 42	32.0 40	32.5 41	32.6 45	32.2 50	31.8 53	31.3 54
73	RA DEC	23 3 15 5	42.2 36	42.0 32	41.9 29	42.2 27	42.8 27	43.7 31	44.6 37	45.4 44	45.8 50	45.9 55	45.6 56	45.2 56	44.9 53

Table 10b. Apparent Places of Stars, 1979 (Mils of Declination)

STAR NO.	Right ascension	(Hr Min)	Zero hours universal time (GMT) of first day of month												
	Declination	(Mils)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
			Right Ascension (seconds)—Declination (mils)												
1	RA DEC	0 7 515	17.9 0.14	17.5 0.12	17.2 0.10	17.3 0.08	17.8 0.07	18.6 0.07	19.6 0.10	20.6 0.13	21.2 0.17	21.5 0.20	21.4 0.22	21.1 0.23	20.6 0.23
2	RA DEC	0 8 1049	3.5 0.57	2.5 0.55	1.9 0.52	1.9 0.47	2.7 0.44	4.0 0.43	5.5 0.45	6.9 0.48	7.8 0.53	8.1 0.58	7.9 0.63	7.2 0.65	6.3 0.66
3	RA DEC	0 24 -1375	36.9 0.62	34.4 0.60	32.9 0.56	32.5 0.50	33.5 0.44	35.9 0.40	39.0 0.38	42.2 0.38	44.6 0.41	45.5 0.45	44.8 0.50	42.8 0.53	40.0 0.53
4	RA DEC	0 25 -754	14.1 0.22	13.5 0.21	13.2 0.19	13.2 0.15	13.6 0.10	14.5 0.06	15.6 0.03	16.7 0.02	17.5 0.03	17.9 0.05	17.8 0.09	17.4 0.12	16.8 0.13
5	RA DEC	0 39 1003	19.2 0.13	18.3 0.12	17.6 0.09	17.5 0.05	18.0 0.02	19.1 0.01	20.5 0.02	21.9 0.05	23.0 0.09	23.5 0.14	23.4 0.18	23.0 0.21	22.1 0.22
6	RA DEC	0 42 -321	31.8 0.86	31.4 0.86	31.1 0.86	31.1 0.84	31.4 0.81	32.1 0.77	33.0 0.74	34.0 0.72	34.7 0.71	35.1 0.72	35.1 0.74	34.9 0.76	34.5 0.77
7	RA DEC	0 55 1077	26.9 0.46	25.8 0.45	25.0 0.42	24.7 0.38	25.2 0.35	26.4 0.33	27.9 0.34	29.5 0.36	30.7 0.41	31.4 0.45	31.4 0.50	30.9 0.53	30.0 0.55
8	RA DEC	1 24 1068	27.2 0.98	26.1 0.97	25.2 0.95	24.8 0.91	25.1 0.88	26.2 0.86	27.7 0.86	29.3 0.88	30.6 0.92	31.5 0.96	31.7 1.01	31.4 1.04	30.6 1.06
9	RA DEC	1 36 -1019	55.7 0.54	54.7 0.54	53.9 0.52	53.3 0.47	53.4 0.42	54.1 0.37	55.4 0.33	56.8 0.31	58.1 0.32	58.9 0.35	59.1 0.40	58.6 0.44	57.8 0.46

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See Table 11. Apparent Places of Polaris, 1979

11	RA DEC	2 5 415	59.8 0.36	59.3 0.35	58.9 0.34	58.6 0.32	58.7 0.32	59.2 0.32	60.1 0.33	61.1 0.36	62.0 0.38	62.6 0.41	62.9 0.42	63.0 0.43	62.8 0.43
12	RA DEC	2 57 -717	28.4 1.11	27.7 1.13	27.1 1.12	26.5 1.10	26.3 1.06	26.6 1.01	27.3 0.96	28.3 0.93	29.4 0.92	30.2 0.93	30.7 0.97	30.8 1.01	30.4 1.04
13	RA DEC	3 1 71	11.5 0.22	11.1 0.21	10.6 0.20	10.2 0.20	10.2 0.21	10.5 0.23	11.2 0.25	12.1 0.28	13.0 0.30	13.7 0.30	14.1 0.30	14.3 0.29	14.2 0.28
14	RA DEC	3 22 885	50.6 0.13	50.0 0.14	49.2 0.13	48.5 0.11	48.3 0.08	48.7 0.06	49.6 0.05	50.9 0.05	52.2 0.07	53.3 0.10	54.1 0.13	54.5 0.16	54.4 0.19
15	RA DEC	4 34 292	43.9 0.73	43.7 0.73	43.2 0.72	42.7 0.72	42.4 0.72	42.5 0.72	43.0 0.73	43.8 0.74	44.7 0.76	45.6 0.77	46.3 0.77	46.8 0.77	47.0 0.76
16	RA DEC	5 13 -146	32.8 0.28	32.6 0.30	32.1 0.31	31.6 0.31	31.2 0.30	31.1 0.28	31.4 0.25	32.1 0.22	32.9 0.20	33.8 0.20	34.5 0.21	35.1 0.23	35.3 0.26
17	RA DEC	5 15 817	9.9 0.36	9.6 0.38	9.0 0.39	8.2 0.39	7.7 0.37	7.6 0.35	8.1 0.33	9.0 0.32	10.2 0.32	11.5 0.33	12.6 0.34	13.4 0.36	13.8 0.38
18	RA DEC	5 23 112	61.4 0.51	61.2 0.50	60.8 0.50	60.2 0.49	59.9 0.50	59.8 0.51	60.1 0.53	60.8 0.55	61.6 0.56	62.5 0.56	63.3 0.56	63.9 0.55	64.2 0.53
19	RA DEC	5 24 508	59.1 0.24	59.0 0.25	58.5 0.25	57.9 0.25	57.5 0.25	57.4 0.24	57.8 0.24	58.5 0.24	59.5 0.24	60.5 0.25	61.4 0.25	62.1 0.26	62.5 0.26

Table 10b. Apparent Places of Stars, 1979 (Mils of Declination)—Continued

STAR NO.	Right ascension (Hr Min)		Zero hours universal time (GMT) of first day of month												
	Declination (Mils)	(Mils)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
			Right Ascension (seconds)—Declination (mils)												
20	RA DEC	5 35 -21	10.0 0.64	9.9 0.66	9.5 0.67	8.9 0.67	8.5 0.66	8.4 0.64	8.7 0.62	9.3 0.60	10.1 0.58	10.9 0.58	11.7 0.59	12.3 0.61	12.7 0.63
21	RA DEC	5 39 -34	43.1 0.77	43.0 0.79	42.6 0.80	42.0 0.80	41.6 0.79	41.5 0.77	41.8 0.75	42.3 0.73	43.2 0.71	44.0 0.71	44.8 0.72	45.4 0.74	45.8 0.76
22	RA DEC	5 54 131	3.2 0.58	3.2 0.57	2.8 0.56	2.2 0.56	1.8 0.57	1.7 0.58	1.9 0.59	2.5 0.61	3.3 0.62	4.2 0.62	5.0 0.61	5.7 0.60	6.1 0.59
23	RA DEC	6 23 -936	31.4 0.66	31.1 0.70	30.3 0.73	29.2 0.74	28.2 0.73	27.6 0.69	27.5 0.64	28.0 0.59	28.9 0.56	30.1 0.55	31.3 0.56	32.2 0.61	32.6 0.66
24	RA DEC	6 36 291	31.1 0.83	31.2 0.82	30.9 0.82	30.4 0.83	29.9 0.83	29.7 0.83	29.8 0.84	30.3 0.84	31.1 0.85	31.9 0.85	32.9 0.84	33.7 0.83	34.2 0.82
25	RA DEC	6 44 -296	14.5 0.71	14.6 0.74	14.2 0.76	13.6 0.77	13.1 0.76	12.8 0.74	12.8 0.71	13.2 0.68	13.9 0.65	14.8 0.65	15.6 0.66	16.4 0.69	16.9 0.73
26	RA DEC	6 57 -514	49.5 0.58	49.5 0.63	49.2 0.65	48.5 0.66	47.9 0.65	47.5 0.63	47.4 0.59	47.8 0.55	48.4 0.52	49.3 0.51	50.2 0.52	51.1 0.56	51.6 0.60
27	RA DEC	7 7 -468	33.7 0.65	33.7 0.69	33.4 0.72	32.8 0.73	32.2 0.72	31.8 0.70	31.7 0.66	32.0 0.62	32.7 0.60	33.5 0.58	34.4 0.60	35.3 0.63	35.8 0.67
28	RA DEC	7 33 567	16.8 0.68	17.1 0.69	16.9 0.70	16.3 0.71	15.7 0.72	15.4 0.71	15.3 0.71	15.7 0.70	16.4 0.68	17.3 0.67	18.4 0.66	19.4 0.65	20.2 0.65
29	RA DEC	7 38 93	13.4 0.81	13.6 0.79	13.4 0.78	12.9 0.78	12.4 0.79	12.1 0.79	12.1 0.81	12.4 0.82	13.0 0.83	13.7 0.82	14.6 0.81	15.5 0.79	16.1 0.77
30	RA DEC	7 44 499	3.1 0.10	3.4 0.11	3.2 0.12	2.7 0.13	2.1 0.13	1.8 0.13	1.7 0.13	2.0 0.12	2.7 0.11	3.5 0.10	4.6 0.08	5.5 0.07	6.3 0.07
31	RA DEC	8 8 -840	55.2 0.44	55.5 0.50	55.1 0.54	54.4 0.57	53.5 0.57	52.7 0.55	52.3 0.52	52.4 0.47	52.9 0.43	53.8 0.41	54.9 0.41	56.0 0.44	56.8 0.49
32	RA DEC	8 22 -1056	8.0 0.74	8.3 0.80	7.8 0.84	6.8 0.88	5.6 0.89	4.5 0.87	3.8 0.84	3.6 0.79	4.1 0.74	5.2 0.71	6.6 0.71	8.0 0.74	9.1 0.79
33	RA DEC	9 7 -770	15.2 0.61	15.7 0.66	15.6 0.71	15.1 0.74	14.4 0.75	13.6 0.74	13.2 0.72	13.0 0.68	13.3 0.64	13.9 0.61	15.0 0.60	16.1 0.63	17.1 0.67
34	RA DEC	9 12 -1237	62.9 0.85	63.6 0.91	63.3 0.96	62.0 1.00	60.3 1.02	58.5 1.02	57.1 1.00	56.4 0.95	56.6 0.90	57.8 0.87	59.6 0.85	61.7 0.87	63.4 0.91
35	RA DEC	9 26 -152	34.2 0.33	34.8 0.36	34.9 0.38	34.6 0.39	34.2 0.39	33.8 0.38	33.5 0.37	33.5 0.35	33.7 0.33	34.2 0.32	35.0 0.33	35.9 0.36	36.8 0.39
36	RA DEC	10 7 214	15.8 0.54	16.5 0.52	16.8 0.52	16.6 0.52	16.3 0.53	15.8 0.54	15.6 0.55	15.4 0.56	15.6 0.55	16.0 0.54	16.8 0.52	17.7 0.49	18.7 0.47
37	RA DEC	11 0 1004	34.9 0.27	36.1 0.28	36.8 0.31	36.7 0.35	36.1 0.38	35.3 0.39	34.5 0.39	33.9 0.37	33.8 0.33	34.2 0.28	35.2 0.24	36.5 0.20	38.1 0.19

Table 10b. Apparent Places of Stars, 1979 (Mils of Declination)—Continued

STAR NO.	Right ascension (Hr Min Declination (Mils)		Zero hours universal time (GMT) of first day of month												
			JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
			Right Ascension (seconds)—Declination (mils)												
38	RA DEC	11 2 1099	26.4 0.72	27.9 0.73	28.6 0.76	28.5 0.81	27.8 0.84	26.7 0.86	25.8 0.85	25.1 0.82	24.9 0.78	25.3 0.73	26.4 0.69	27.9 0.65	29.7 0.64
39	RA DEC	11 47 261	59.3 0.12	60.2 0.09	60.7 0.09	60.9 0.10	60.7 0.11	60.4 0.12	60.1 0.14	59.8 0.14	59.6 0.13	59.7 0.12	60.2 0.09	61.0 0.06	62.0 0.03
40	RA DEC	11 52 956	43.3 0.57	44.6 0.57	45.4 0.59	45.6 0.63	45.3 0.66	44.6 0.69	43.9 0.69	43.2 0.68	42.8 0.64	42.9 0.60	43.6 0.55	44.7 0.51	46.1 0.48
41	RA DEC	12 14 -309	43.6 0.75	44.5 0.79	45.1 0.82	45.3 0.84	45.3 0.85	45.0 0.85	44.7 0.85	44.3 0.83	44.1 0.81	44.1 0.80	44.5 0.80	45.3 0.81	46.3 0.84
42	RA DEC	12 25 -1119	26.5 0.60	28.1 0.63	29.1 0.68	29.6 0.73	29.4 0.77	28.7 0.80	27.6 0.81	26.5 0.80	25.7 0.77	25.5 0.73	26.1 0.69	27.5 0.67	29.3 0.68
43	RA DEC	12 30 -1013	0.4 0.17	1.9 0.20	2.8 0.24	3.2 0.29	3.1 0.34	2.5 0.36	1.7 0.37	0.9 0.36	0.2 0.33	0.0 0.29	0.5 0.26	1.7 0.24	3.3 0.25
44	RA DEC	12 46 -1059	29.8 0.0	31.4 0.03	32.4 0.07	33.0 0.12	33.0 0.17	32.5 0.20	31.6 0.21	30.6 0.20	29.8 0.17	29.6 0.13	30.0 0.10	31.2 0.08	32.8 0.08
45	RA DEC	12 53 996	5.3 0.79	6.8 0.78	7.8 0.80	8.3 0.83	8.2 0.87	7.6 0.91	6.8 0.92	6.0 0.92	5.3 0.89	5.0 0.84	5.4 0.79	6.2 0.74	7.7 0.70
46	RA DEC	13 23 978	3.4 0.33	4.9 0.31	6.0 0.33	6.7 0.36	6.7 0.40	6.3 0.44	5.5 0.46	4.6 0.46	3.9 0.43	3.5 0.39	3.6 0.34	4.3 0.29	5.6 0.25
47	RA DEC	13 24 -196	4.7 0.45	5.7 0.48	6.4 0.50	6.9 0.52	7.0 0.52	7.0 0.52	6.7 0.51	6.3 0.50	5.9 0.49	5.8 0.49	5.9 0.49	6.5 0.51	7.5 0.53
48	RA DEC	13 46 878	41.4 0.48	42.7 0.46	43.7 0.47	44.4 0.50	44.6 0.54	44.3 0.58	43.7 0.60	43.0 0.60	42.3 0.59	41.8 0.55	41.8 0.50	42.4 0.45	43.5 0.40
49	RA DEC	14 2 -1071	19.5 0.40	21.2 0.42	22.6 0.45	23.6 0.49	24.1 0.54	24.0 0.57	23.4 0.60	22.4 0.60	21.4 0.58	20.8 0.55	20.8 0.51	21.6 0.49	23.2 0.48
50	RA DEC	14 5 -644	26.1 0.67	27.2 0.70	28.1 0.73	28.8 0.76	29.1 0.78	29.2 0.80	28.9 0.81	28.4 0.81	27.8 0.79	27.5 0.77	27.5 0.75	28.1 0.75	29.1 0.75
51	RA DEC	14 14 342	41.2 0.95	42.2 0.92	43.0 0.91	43.6 0.91	43.9 0.93	43.9 0.96	43.6 0.98	43.2 0.99	42.7 0.99	42.4 0.97	42.4 0.94	42.8 0.90	43.6 0.86
52	RA DEC	14 38 -1079	9.9 0.84	11.6 0.85	13.0 0.88	14.2 0.92	14.8 0.96	14.8 1.00	14.3 1.02	13.3 1.03	12.2 1.02	11.4 0.99	11.2 0.95	11.9 0.92	13.3 0.91
53	RA DEC	14 49 -283	42.0 0.60	43.0 0.62	43.8 0.64	44.5 0.66	45.0 0.67	45.1 0.67	45.0 0.66	44.6 0.66	44.2 0.65	43.8 0.64	43.7 0.64	44.1 0.65	44.9 0.67
54	RA DEC	14 50 1319	40.6 0.80	43.1 0.77	45.5 0.77	47.5 0.81	48.2 0.85	47.7 0.90	46.2 0.93	44.0 0.94	41.6 0.93	39.8 0.89	38.7 0.84	39.0 0.78	40.6 0.73
55	RA DEC	15 33 476	46.5 0.17	47.4 0.14	48.3 0.12	49.1 0.13	49.6 0.16	49.8 0.19	49.7 0.22	49.3 0.24	48.7 0.25	48.2 0.23	47.9 0.20	48.1 0.16	48.7 0.12

Table 10b. Apparent Places of Stars, 1979 (Mils of Declination)—Continued

STAR NO.	Right ascension (Hr Min) Declination (Mils)		Zero hours universal time (GMT) of first day of month												
			JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
			Right Ascension (seconds)—Declination (mils)												
56	RA DEC	15 59 -401	4.1 0.06	5.1 0.07	6.0 0.09	6.9 0.10	7.5 0.11	7.9 0.11	8.0 0.12	7.7 0.12	7.2 0.11	6.7 0.11	6.4 0.10	6.6 0.10	7.2 0.11
57	RA DEC	16 28 -469	5.7 0.03	6.6 0.04	7.5 0.05	8.5 0.06	9.2 0.07	9.7 0.08	9.9 0.08	9.6 0.09	9.1 0.09	8.6 0.08	8.2 0.07	8.3 0.07	8.9 0.07
58	RA DEC	16 46 -1226	22.6 0.42	24.6 0.40	26.7 0.40	28.9 0.41	30.8 0.44	31.9 0.48	32.2 0.52	31.4 0.55	30.0 0.56	28.5 0.55	27.3 0.53	27.1 0.49	28.2 0.45
59	RA DEC	17 9 -279	8.8 0.06	9.6 0.08	10.5 0.09	11.4 0.09	12.1 0.09	12.7 0.09	13.0 0.08	12.9 0.08	12.4 0.07	11.9 0.07	11.5 0.07	11.4 0.08	11.9 0.09
60	RA DEC	17 32 -659	9.1 0.31	9.9 0.31	10.9 0.31	12.0 0.31	13.0 0.32	13.7 0.33	14.1 0.34	14.0 0.36	13.6 0.37	12.9 0.36	12.3 0.36	12.2 0.34	12.6 0.33
61	RA DEC	17 33 223	56.0 0.58	56.6 0.55	57.4 0.53	58.3 0.53	59.1 0.54	59.6 0.57	59.9 0.60	59.8 0.62	59.4 0.63	58.8 0.63	58.3 0.62	58.2 0.60	58.5 0.56
62	RA DEC	17 56 915	4.7 0.42	5.4 0.37	6.4 0.34	7.6 0.34	8.7 0.36	9.4 0.41	9.7 0.46	9.3 0.50	8.5 0.53	7.5 0.53	6.5 0.51	5.9 0.47	6.0 0.42
63	RA DEC	18 22 -611	44.8 0.44	45.5 0.43	46.3 0.42	47.4 0.42	48.4 0.42	49.3 0.42	49.8 0.43	49.9 0.44	49.5 0.45	48.9 0.46	48.3 0.46	48.1 0.45	48.3 0.43
64	RA DEC	18 36 689	11.8 0.17	12.3 0.12	13.0 0.09	14.0 0.08	15.0 0.10	15.8 0.14	16.2 0.18	16.1 0.23	15.6 0.26	14.9 0.27	14.1 0.25	13.6 0.22	13.6 0.18
65	RA DEC	18 53 -467	56.0 0.95	56.5 0.94	57.3 0.94	58.2 0.93	59.2 0.93	60.1 0.92	60.7 0.92	60.8 0.92	60.6 0.93	60.1 0.94	59.5 0.94	59.2 0.94	59.3 0.93
66	RA DEC	19 49 156	44.1 0.70	44.3 0.67	44.8 0.65	45.6 0.65	46.5 0.66	47.3 0.69	47.9 0.72	48.2 0.75	48.1 0.77	47.7 0.77	47.1 0.77	46.7 0.76	46.6 0.73
67	RA DEC	20 23 -1009	56.6 0.85	56.9 0.81	57.7 0.78	58.9 0.75	60.4 0.73	61.9 0.73	63.1 0.74	63.8 0.77	63.7 0.80	63.1 0.82	62.1 0.84	61.2 0.83	60.9 0.80
68	RA DEC	20 40 803	41.5 0.71	41.5 0.66	41.8 0.62	42.7 0.60	43.7 0.60	44.9 0.62	45.7 0.67	46.1 0.72	45.9 0.76	45.4 0.79	44.5 0.80	43.8 0.79	43.3 0.76
69	RA DEC	21 39 -1377	4.5 0.55	3.9 0.51	4.6 0.46	6.6 0.41	9.6 0.38	13.2 0.36	16.3 0.37	18.4 0.40	19.0 0.45	17.9 0.49	15.4 0.51	12.7 0.51	10.6 0.48
70	RA DEC	21 43 173	8.2 0.86	8.1 0.84	8.3 0.83	8.8 0.82	9.6 0.83	10.5 0.85	11.4 0.89	11.9 0.92	12.1 0.94	12.0 0.96	11.6 0.96	11.1 0.95	10.8 0.93
71	RA DEC	22 6 -836	52.9 0.73	52.7 0.70	52.9 0.67	53.5 0.63	54.5 0.60	55.8 0.57	57.0 0.56	57.9 0.57	58.3 0.60	58.1 0.62	57.5 0.65	56.8 0.66	56.3 0.65
72	RA DEC	22 56 -528	28.4 0.64	28.1 0.64	28.1 0.62	28.5 0.59	29.2 0.56	30.1 0.52	31.2 0.50	32.0 0.49	32.5 0.50	32.6 0.52	32.2 0.54	31.8 0.56	31.3 0.56
73	RA DEC	23 3 268	42.2 0.33	42.0 0.31	41.9 0.29	42.2 0.28	42.8 0.28	43.7 0.30	44.6 0.33	45.4 0.37	45.8 0.40	45.9 0.42	45.6 0.43	45.2 0.42	44.9 0.41

Table 11. Apparent Places of Polaris (Star No. 10), 1979
Zero hours universal time (GMT) on 0, 10th, 20th, 30th Days of Month

	Declination				Right Ascension		
	Deg	Min	Sec	Mils	Hr	Min	Sec
JAN 0	89	10	20	1585.28	2	12	9
10			22	1585.29		11	55
20			23	1585.30			40
30			23	1585.30			26
FEB 0	89	10	23	1585.30	2	11	24
10			23	1585.30			9
20			21	1585.29		10	55
30			20	1585.28			41
MAR 0	89	10	20	1585.29	2	10	44
10			18	1585.28			33
20			16	1585.26			23
30			13	1585.25			15
APR 0	89	10	13	1585.25	2	10	15
10			10	1585.23			11
20			6	1585.22			10
30			3	1585.20			12
MAY 0	89	10	3	1585.20	2	10	12
10			0	1585.19			15
20		9	58	1585.17			22
30			55	1585.16			32
JUN 0	89	9	55	1585.16	2	10	33
10			53	1585.15			44
20			52	1585.14			56
30			51	1585.14		11	10
JUL 0	89	9	51	1585.14	2	11	10
10			50	1585.14			25
20			50	1585.14			40
30			51	1585.14			55
AUG 0	89	9	51	1585.14	2	11	57
10			52	1585.15		12	12
20			54	1585.16			27
30			56	1585.17			40
SEP 0	89	9	56	1585.17	2	12	42
10			59	1585.18			54
20		10	2	1585.20		13	5
30			5	1585.21			15
OCT 0	89	10	5	1585.21	2	13	15
10			9	1585.23			22
20			12	1585.25			27
30			16	1585.26			30
NOV 0	89	10	16	1585.27	2	13	30
10			20	1585.28			31
20			24	1585.30			28
30			27	1585.32			23
DEC 0	89	10	27	1585.32	2	13	23
10			30	1585.34			16
20			33	1585.35			6
30			35	1585.36		12	54
JAN 0	89	10	35	1585.36	2	12	53

Table 12. To Determine Azimuth from Polaris

PURPOSE: The purpose of this table is to provide a fast, simple method of determining 5th order azimuths from observations of Polaris. When the appropriate secant table (following) is used, use of logarithms is unnecessary.

GUIDE FOR USE:

1. Determine local sidereal time (LST) of observation as described in FM 6-2.
2. Enter the table with this LST and extract the corresponding b_0 , b_1 , and b_2 .
3. Algebraically add b_0 , b_1 , and b_2 .
4. Select the appropriate secant table depending whether the results are to be in minutes of arc or mils. It is advisable to "X" out the secant table that will not be used. Using degrees of latitude, extract the corresponding secant and DIFF 1' OF LAT. ($\times 100000$). Round the minutes and seconds of latitude to the nearest whole minute; multiply this by the DIFF 1'; round to the nearest 10; move the decimal five places to the left; and add the result to the secant.
5. Multiply the result of 4 above by the sum of $b_0 + b_1 + b_2$ and round to the nearest 0.1; this, with the sign of $b_0 + b_1 + b_2$, is the azimuth angle.
6. Add the azimuth angle algebraically to 6400 mils (or 360 degrees) to get the azimuth to Polaris. Subtract the mean horizontal angle (clockwise, from azimuth mark to Polaris) from the azimuth to Polaris to get the azimuth to the mark. If the azimuth to the mark exceeds 6400, subtract 6400.

EXAMPLE:

Required: Astronomic azimuth

Known: LST of observation = 5 hr 27 min

Latitude = $34^\circ 37' 45''$

Month = May 1976

Mean horizontal angle from mark to Polaris = 1320.5 μ

From TABLE 12, 1976: $b_0 = -38.8$, $b_1 = +.2$, $b_2 = -.3$

$b_0 + b_1 + b_2 = (-38.8) + (+.2) + (-.3) = -38.9$

Results are needed in mils so the SECANT TABLE,

Results in Mils, is used.

DEGREES LATITUDE	SECANT ($\times \mu$ conv.)	DIFF. 1' OF LAT. ($\times 100000$)
34	0.3574	7.2

Minutes and seconds of latitude rounded to nearest whole minute = 38;
 $38 \times 7.2 = 273.6$; rounding to nearest 10 yields 270; moving the decimal
 five places to the left yields .0027; $0.3574 + .0027 = 0.3601$

$-38.9 \times 0.3601 = -14.00789$; rounded to the nearest 0.1 μ , this yields

AZIMUTH ANGLE = -14.0 μ

AZIMUTH TO MARK = $-14.0 + 6400 - 1320.5 = 5065.5 \mu$

SECANT TABLE, Results in Mils

DEGREES LATITUDE	SECANT (N of CONV.)	DIFF. 1' OF LAT. (X 100000)	DEGREES LATITUDE	SECANT (N of CONV.)	DIFF. 1' OF LAT. (X 100000)	DEGREES LATITUDE	SECANT (N of CONV.)	DIFF. 1' OF LAT. (X 100000)
0	0.2963	0.1	23	0.3219	4.1	46	0.4265	13.2
1	0.2963	0.2	24	0.3243	4.3	47	0.4345	13.9
2	0.2965	0.4	25	0.3269	4.6	48	0.4428	14.7
3	0.2967	0.5	26	0.3297	4.8	49	0.4516	15.5
4	0.2970	0.7	27	0.3325	5.1	50	0.4610	16.4
5	0.2974	0.8	28	0.3356	5.3	51	0.4708	17.4
6	0.2979	1.0	29	0.3388	5.6	52	0.4813	18.5
7	0.2985	1.1	30	0.3421	5.9	53	0.4923	19.6
8	0.2992	1.3	31	0.3457	6.2	54	0.5041	20.8
9	0.3000	1.5	32	0.3494	6.5	55	0.5166	22.1
10	0.3009	1.6	33	0.3533	6.8	56	0.5299	23.6
11	0.3018	1.8	34	0.3574	7.2	57	0.5440	25.2
12	0.3029	2.0	35	0.3617	7.6	58	0.5591	26.9
13	0.3041	2.1	36	0.3662	7.9	59	0.5753	28.8
14	0.3054	2.3	37	0.3710	8.3	60	0.5926	30.9
15	0.3067	2.5	38	0.3760	8.8	61	0.6112	33.3
16	0.3082	2.7	39	0.3813	9.2	62	0.6311	35.9
17	0.3098	2.8	40	0.3868	9.7	63	0.6526	38.8
18	0.3115	3.0	41	0.3926	10.2	64	0.6759	42.0
19	0.3134	3.2	42	0.3987	10.7	65	0.7011	45.6
20	0.3153	3.4	43	0.4051	11.3	66	0.7285	49.7
21	0.3174	3.6	44	0.4119	11.9	67	0.7583	
22	0.3196	3.9	45	0.4190	12.5			

SECANT TABLE, Results in Minutes of Arc

DEGREES LATITUDE	NATURAL SECANT	DIFF. 1' OF LAT. (N 100000)	DEGREES LATITUDE	NATURAL SECANT	DIFF. 1' OF LAT. (N 100000)	DEGREES LATITUDE	NATURAL SECANT	DIFF. 1' OF LAT. (N 100000)
0	1.000	0.	23	1.086	14.	46	1.440	45.
1	1.000	1.	24	1.095	15.	47	1.466	47.
2	1.001	1.	25	1.103	15.	48	1.494	50.
3	1.001	2.	26	1.113	16.	49	1.524	52.
4	1.002	2.	27	1.122	17.	50	1.556	55.
5	1.004	3.	28	1.133	18.	51	1.589	59.
6	1.006	3.	29	1.143	19.	52	1.624	62.
7	1.008	4.	30	1.155	20.	53	1.662	66.
8	1.010	4.	31	1.167	21.	54	1.701	70.
9	1.012	5.	32	1.179	22.	55	1.743	75.
10	1.015	5.	33	1.192	23.	56	1.788	80.
11	1.019	6.	34	1.206	24.	57	1.836	85.
12	1.022	7.	35	1.221	25.	58	1.887	91.
13	1.026	7.	36	1.236	27.	59	1.942	97.
14	1.031	8.	37	1.252	28.	60	2.000	104.
15	1.035	8.	38	1.269	30.	61	2.063	112.
16	1.040	9.	39	1.287	31.	62	2.130	121.
17	1.046	10.	40	1.305	33.	63	2.203	131.
18	1.051	10.	41	1.325	34.	64	2.281	142.
19	1.058	11.	42	1.346	36.	65	2.366	154.
20	1.064	12.	43	1.367	38.	66	2.459	168.
21	1.071	12.	44	1.390	40.	67	2.559	
22	1.079	13.	45	1.414	42.			

Table 12. To Determine Azimuth from Polaris, 1979

L.S.T.	0 ^h	1 ^h	2 ^h	3 ^h	4 ^h	5 ^h	6 ^h	7 ^h	8 ^h	9 ^h	10 ^h	11 ^h
	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀	<i>b</i> ₀
M												
0	27.6	15.7	2.7	-10.6	-23.1	-33.9	-42.3	-47.8	-49.9	-48.7	-44.1	-36.7
3	27.0	15.0	2.0	-11.3	-23.7	-34.4	-42.7	-48.0	-49.9	-48.5	-43.8	-36.2
6	26.5	14.4	1.3	-11.9	-24.3	-34.9	-43.0	-48.1	-50.0	-48.4	-43.5	-35.8
9	25.9	13.8	0.7	-12.6	-24.8	-35.3	-43.3	-48.3	-50.0	-48.2	-43.2	-35.3
12	25.3	13.1	-0.1	-13.2	-25.4	-35.8	-43.7	-48.5	-49.9	-48.0	-42.9	-34.9
15	24.8	12.5	-0.8	-13.9	-26.0	-36.3	-44.0	-48.6	-49.9	-47.8	-42.5	-34.4
18	24.2	11.9	-1.4	-14.5	-26.5	-36.7	-44.3	-48.8	-49.9	-47.6	-42.2	-33.9
21	23.6	11.2	-2.1	-15.1	-27.1	-37.2	-44.6	-48.9	-49.9	-47.4	-41.8	-33.5
24	23.0	10.6	-2.8	-15.8	-27.7	-37.6	-44.9	-49.0	-49.8	-47.2	-41.5	-33.0
27	22.4	9.9	-3.4	-16.4	-28.2	-38.0	-45.2	-49.2	-49.8	-47.0	-41.1	-32.5
30	21.8	9.3	-4.1	-17.0	-28.8	-38.4	-45.4	-49.3	-49.7	-46.8	-40.7	-32.0
33	21.2	8.6	-4.7	-17.6	-29.3	-38.9	-45.7	-49.4	-49.7	-46.6	-40.4	-31.5
36	20.6	7.9	-5.4	-18.3	-29.8	-39.3	-46.0	-49.5	-49.6	-46.3	-40.0	-31.0
39	20.0	7.3	-6.1	-18.9	-30.4	-39.7	-46.2	-49.6	-49.5	-46.1	-39.6	-30.5
42	19.4	6.6	-6.7	-19.5	-30.9	-40.1	-46.5	-49.6	-49.4	-45.8	-39.2	-30.0
45	18.8	6.0	-7.4	-20.1	-31.4	-40.5	-46.7	-49.7	-49.3	-45.6	-38.8	-29.5
48	18.2	5.3	-8.0	-20.7	-31.9	-40.9	-46.9	-49.8	-49.2	-45.3	-38.4	-28.9
51	17.6	4.7	-8.7	-21.3	-32.4	-41.2	-47.2	-49.8	-49.1	-45.0	-38.0	-28.4
54	16.9	4.0	-9.3	-21.9	-32.9	-41.6	-47.4	-49.9	-49.0	-44.7	-37.5	-27.9
57	16.3	3.3	-10.0	-22.5	-33.4	-42.0	-47.6	-49.9	-48.8	-44.4	-37.1	-27.3
60	15.7	2.7	-10.6	-23.1	-33.9	-42.3	-47.8	-49.9	-48.7	-44.1	-36.7	-26.8
Lat	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁	<i>b</i> ₁
0	-0.3	0.0	0.2	0.3	0.4	0.4	0.3	0.0	-0.2	-0.3	-0.4	-0.4
10	-0.2	0.0	0.2	0.3	0.4	0.3	0.2	0.0	-0.2	-0.3	-0.4	-0.3
20	-0.2	0.0	0.1	0.2	0.3	0.3	0.2	0.0	-0.1	-0.2	-0.3	-0.3
30	-0.1	0.0	0.1	0.2	0.2	0.2	0.1	0.0	-0.1	-0.2	-0.2	-0.2
40	-0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.0	-0.1	-0.1	-0.1	-0.1
45	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	-0.1	-0.1	-0.1
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	0.1	0.0	0.0	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.1	0.1	0.1
60	0.1	0.0	-0.1	-0.2	-0.2	-0.2	-0.1	0.0	0.1	0.2	0.2	0.2
62	0.1	0.0	-0.1	-0.2	-0.2	-0.2	-0.1	0.0	0.1	0.2	0.2	0.2
64	0.2	0.0	-0.1	-0.3	-0.3	-0.3	-0.2	0.0	0.1	0.3	0.3	0.3
66	0.2	0.0	-0.2	-0.3	-0.4	-0.3	-0.2	0.0	0.2	0.3	0.4	0.3
Month	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂	<i>b</i> ₂
JAN	-0.1	-0.1	0.0	0.0	0.1	0.2	0.2	0.2	0.3	0.3	0.2	0.2
FEB	-0.3	-0.2	-0.2	-0.1	0.0	0.1	0.1	0.2	0.3	0.3	0.3	0.3
MAR	-0.3	-0.3	-0.3	-0.2	-0.2	-0.1	0.0	0.1	0.2	0.2	0.3	0.3
APR	-0.3	-0.3	-0.3	-0.3	-0.3	-0.2	-0.2	-0.1	0.0	0.1	0.2	0.3
MAY	-0.2	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.1	0.0	0.0	0.1
JUN	-0.1	-0.1	-0.2	-0.2	-0.3	-0.3	-0.3	-0.3	-0.2	-0.2	-0.1	0.0
JUL	0.1	0.0	0.0	-0.1	-0.2	-0.2	-0.2	-0.3	-0.3	-0.2	-0.2	-0.2
AUG	0.2	0.2	0.1	0.1	0.0	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2
SEP	0.3	0.3	0.3	0.2	0.2	0.1	0.1	0.0	-0.1	-0.1	-0.2	-0.2
OCT	0.2	0.3	0.3	0.4	0.3	0.3	0.3	0.2	0.1	0.0	-0.1	-0.2
NOV	0.2	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.3	0.2	0.1	0.0
DEC	0.0	0.1	0.3	0.4	0.4	0.5	0.5	0.5	0.4	0.4	0.2	0.1

$$\text{AZIMUTH OF POLARIS} = \frac{(b_0 + b_L + b_2)}{\cos \text{LATITUDE}}$$

Table 12. To Determine Azimuth from Polaris, 1979—Continued

L.S.T.	12 ^h	13 ^h	14 ^h	15 ^h	16 ^h	17 ^h	18 ^h	19 ^h	20 ^h	21 ^h	22 ^h	23 ^h
	b_0	b_0	b_0	b_0	b_0	b_0	b_0	b_0	b_0	b_0	b_0	b_0
0	-26.8	-15.2	-2.6	10.3	22.4	33.0	41.5	47.3	49.8	49.0	44.8	37.5
3	-26.3	-14.6	-1.9	10.9	23.0	33.5	41.9	47.5	49.9	48.9	44.5	37.1
6	-25.7	-13.9	-1.3	11.5	23.5	34.0	42.2	47.7	49.9	48.8	44.2	36.6
9	-25.1	-13.3	-0.6	12.2	24.1	34.5	42.6	47.9	49.9	48.6	43.9	36.2
12	-24.6	-12.7	0.1	12.8	24.7	34.9	42.9	48.0	50.0	48.5	43.6	35.7
15	-24.0	-12.1	0.7	13.4	25.2	35.4	43.2	48.2	50.0	48.3	43.3	35.3
18	-23.5	-11.5	1.4	14.0	25.8	35.8	43.6	48.4	50.0	48.1	43.0	34.8
21	-22.9	-10.8	2.0	14.6	26.3	36.3	43.9	48.5	49.9	47.9	42.6	34.3
24	-22.3	-10.2	2.7	15.3	26.9	36.7	44.2	48.7	49.9	47.7	42.3	33.8
27	-21.7	-9.6	3.3	15.9	27.4	37.2	44.5	48.8	49.9	47.6	41.9	33.3
30	-21.2	-8.9	3.9	16.5	27.9	37.6	44.8	49.0	49.9	47.3	41.6	32.9
33	-20.6	-8.3	4.6	17.1	28.5	38.0	45.1	49.1	49.8	47.1	41.2	32.3
36	-20.0	-7.7	5.2	17.7	29.0	38.4	45.3	49.2	49.8	46.9	40.8	31.8
39	-19.4	-7.0	5.9	18.3	29.5	38.8	45.6	49.3	49.7	46.7	40.4	31.3
42	-18.8	-6.4	6.5	18.9	30.0	39.2	45.9	49.4	49.6	46.4	40.0	30.8
45	-18.2	-5.8	7.1	19.5	30.6	39.6	46.1	49.5	49.6	46.2	39.6	30.3
48	-17.6	-5.1	7.8	20.1	31.1	40.0	46.4	49.6	49.5	45.9	39.2	29.8
51	-17.0	-4.5	8.4	20.7	31.6	40.4	46.6	49.7	49.4	45.7	38.8	29.2
54	-16.4	-3.9	9.0	21.2	32.1	40.8	46.8	49.7	49.3	45.4	38.4	28.7
57	-15.8	-3.2	9.7	21.8	32.6	41.2	47.1	49.8	49.1	45.1	38.0	28.1
60	-15.2	-2.6	10.3	22.4	33.0	41.5	47.3	49.8	49.0	44.8	37.5	27.6
Lat	b_1	b_1	b_1	b_1	b_1	b_1	b_1	b_1	b_1	b_1	b_1	b_1
0	-0.3	0.0	0.2	0.3	0.4	0.4	0.3	0.0	-0.2	-0.3	-0.4	-0.4
10	-0.2	0.0	0.2	0.3	0.4	0.3	0.2	0.0	-0.2	-0.3	-0.4	-0.3
20	-0.2	0.0	0.1	0.2	0.3	0.3	0.2	0.0	-0.1	-0.2	-0.3	-0.3
30	-0.1	0.0	0.1	0.2	0.2	0.2	0.1	0.0	-0.1	-0.2	-0.2	-0.2
40	-0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.0	-0.1	-0.1	-0.1	-0.1
45	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	-0.0	-0.1	-0.1	-0.1
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	0.1	0.0	0.0	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.1	0.1	0.1
60	0.1	0.0	-0.1	-0.2	-0.2	-0.2	-0.1	0.0	0.1	0.2	0.2	0.2
62	0.1	0.0	-0.1	-0.2	-0.2	-0.2	-0.1	0.0	0.1	0.2	0.2	0.2
64	0.2	0.0	-0.1	-0.3	-0.3	-0.3	-0.2	0.0	0.1	0.3	0.3	0.3
66	0.2	0.0	-0.2	-0.3	-0.4	-0.3	-0.2	0.0	0.2	0.3	0.4	0.3
Month	b_2	b_2	b_2	b_2	b_2	b_2	b_2	b_2	b_2	b_2	b_2	b_2
JAN	0.1	0.1	0.0	0.0	-0.1	-0.2	-0.2	-0.2	-0.3	-0.3	-0.2	-0.2
FEB	0.3	0.2	0.2	0.1	0.0	-0.1	-0.1	-0.2	-0.3	-0.3	-0.3	-0.3
MAR	0.3	0.3	0.3	0.2	0.2	0.1	0.0	-0.1	-0.2	-0.2	-0.3	-0.3
APR	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.1	0.0	-0.1	-0.2	-0.3
MAY	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.1	0.0	0.0	-0.1
JUN	0.1	0.1	0.2	0.2	0.3	0.3	0.3	0.3	0.2	0.2	0.1	0.0
JUL	-0.1	0.0	0.0	0.1	0.2	0.2	0.2	0.3	0.3	0.2	0.2	0.2
AUG	-0.2	-0.2	-0.1	-0.1	-0.0	-0.1	-0.1	0.2	0.2	0.2	0.2	0.2
SEP	-0.3	-0.3	-0.3	-0.2	-0.2	-0.1	-0.1	0.0	0.1	0.1	0.2	0.2
OCT	-0.2	-0.3	-0.3	-0.4	-0.3	-0.3	-0.3	-0.2	-0.1	0.0	0.1	0.2
NOV	-0.2	-0.3	-0.3	-0.4	-0.4	-0.4	-0.4	-0.4	-0.3	-0.2	-0.1	0.0
DEC	0.0	-0.1	-0.3	-0.4	-0.4	-0.5	-0.5	-0.5	-0.4	-0.4	-0.2	-0.1

$$\text{AZIMUTH OF POLARIS} = \frac{(b_0 + b_1 + b_2)}{\cos \text{LATITUDE}}$$

Table 13. Grid Azimuth Correction, Simultaneous Observation

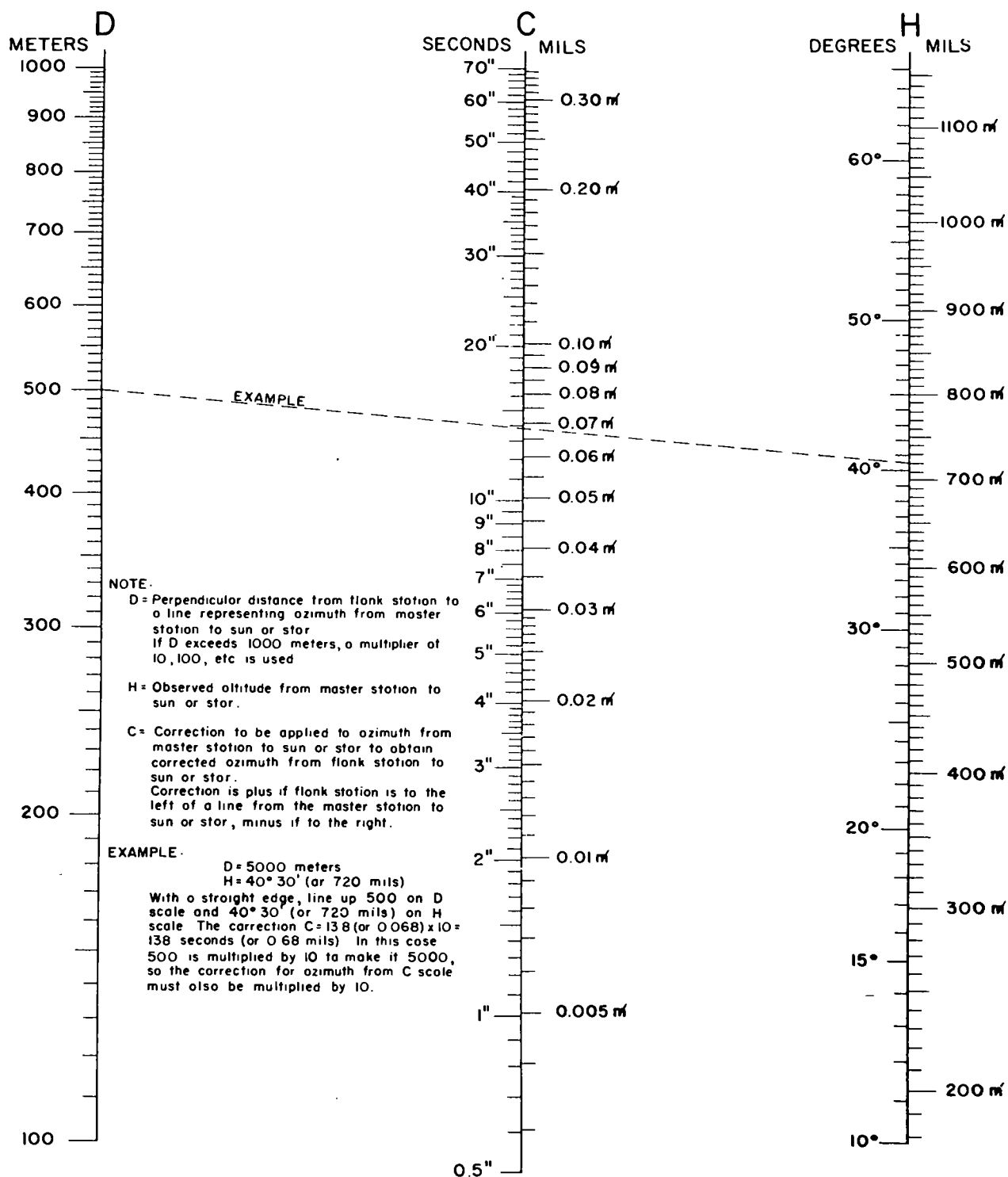


Table 14. Zone-to-Zone Azimuth Transformation

PURPOSE: The purpose of this table is to provide a method for the conversion of UTM grid azimuths in one zone into the corresponding azimuths at an adjacent zone. The table is designed for use in the area between the respective central meridians of the adjacent zones; however, it will yield accurate results a moderate distance outside this area. Results are in mils.

GUIDE FOR USE:

1. Coordinates must be transformed to the adjacent zone by use of TM 5-241-2 or other means.
2. The northing coordinates in each zone are added together. This "total northing" (N) is rounded to the nearest 100 (4th order) or 1000 (5th order). In the Southern Hemisphere the total N must be subtracted from 20,000,000 before entering the table.
3. Find the tabulated Ns between which the total N lies, subtract the lower tabulated N from the total N and move the decimal five places to the left.
4. Multiply this by the "DIFF IN C" located opposite the lower tabulated N.
5. Add this product to the "C" opposite the lower tabulated value. In 5th order computations, this is the change in azimuth; 4th order accuracy requires the following steps.
6. Subtract the smaller of the 2 Ns of the point from the larger, round to the nearest 100, and move the decimal three places to the left. If the resulting number is smaller than the "ALLOWABLE DIFF IN N" opposite the lower tabulated N, no further computations are required and the result from 5 above is the correct change in azimuth. If it is larger, complete the following steps.
7. Square the computed number.
8. Extract from the table the F closest the total N, multiply it by the squared number, round to nearest whole number and move the decimal three places to the left.
9. Add the resulting number to the result of 5 above. The sum is the change in azimuth.
10. The sign of the change in azimuth is determined by use of the following chart:

When the point is transformed from:

(Northern Hemisphere)	(Southern Hemisphere)
East to West, sign is -	East to West, sign is +
West to East, sign is +	West to East, sign is -

Example of a 5th Order Accuracy:

Required: Change in azimuth (C) to nearest 0.1 m.

Known: N (Zone 15) = 3833384

N (Zone 14) = 3830861

$3833384 + 3830861 = 7664245$; round to 7664000, which lies between 7600000 and 7700000 in the table.

7664000 - 7600000 = 64000; moving the decimal five places to the left yields 0.64.

N	C	DIFF IN C
7 600 000	60.157	.691

$$C = 60.157 + (0.64 \times .691) = 60.157 + .442 = 60.599$$

Rounded to the nearest 0.1 m, C = 60.6 m

Example of a 4th Order Accuracy:

Required: Change in azimuth (C) to nearest 0.001 m.

Known: N (Zone 15) = 3834767

N (Zone 14) = 3830679

3834767 + 3830679 = 7665446; round to 7665400, which lies between 7600000 and 7700000 in the table.

7665400 - 7600000 = 65400; moving the decimal five places to the left yields 0.654.

N	C	DIFF IN C	ALLOWABLE DIFF IN N	F
7 600 000	60.157	.691	1.53	0.21
7 700 000			1.54	0.21

$$C = 60.157 + (0.654 \times .691) = 60.157 + .452 = 60.609 \text{ m}$$

3834767 - 3830679 = 4088; rounding to the nearest 100 and moving the decimal three places to the left yields 4.1, which is larger than the closest ALLOWABLE DIFF IN N (1.54). Therefore, further computations are required.

4.1 squared = $4.1 \times 4.1 = 16.8$; $16.8 \times F = 16.8 \times 0.21 = 3.53$; rounding to the nearest whole number and moving the decimal three places to the left yields .004.

$$C = 60.609 + .004 = 60.613 \text{ m}$$

N		C	DIFF IN C	ALLOWABLE DIFF IN N	F
	0	0.0	.842	★	★
100	000	0.842	.842	0.18	15.24
200	000	1.684	.841	0.26	7.62
300	000	2.525	.842	0.31	5.08
400	000	3.367	.841	0.36	3.81
500	000	4.208	.841	0.40	3.05
600	000	5.049	.841	0.44	2.54
700	000	5.890	.840	0.48	2.18
800	000	6.730	.840	0.51	1.91
900	000	7.570	.840	0.54	1.70
1 000	000	8.410	.838	0.57	1.53
1 100	000	9.248	.839	0.60	1.39
1 200	000	10.087	.837	0.63	1.27
1 300	000	10.924	.837	0.65	1.18
1 400	000	11.761	.837	0.68	1.09
1 500	000	12.598	.835	0.70	1.02
1 600	000	13.433	.835	0.72	0.96
1 700	000	14.268	.833	0.75	0.90
1 800	000	15.101	.833	0.77	0.85
1 900	000	15.934	.832	0.79	0.81
2 000	000	16.766	.830	0.81	0.77
2 100	000	17.596	.830	0.83	0.73
2 200	000	18.426	.828	0.85	0.70
2 300	000	19.254	.827	0.87	0.67
2 400	000	20.081	.826	0.88	0.64
2 500	000	20.907	.825	0.90	0.61
2 600	000	21.732	.823	0.92	0.59
2 700	000	22.555	.822	0.94	0.57
2 800	000	23.377	.820	0.95	0.55
2 900	000	24.197	.819	0.97	0.53
3 000	000	25.016	.817	0.99	0.51
3 100	000	25.833	.815	1.00	0.50
3 200	000	26.648	.814	1.02	0.48
3 300	000	27.462	.812	1.03	0.47
3 400	000	28.274	.810	1.05	0.45
3 500	000	29.084	.809	1.06	0.44
3 600	000	29.893	.806	1.08	0.43
3 700	000	30.699	.805	1.09	0.42
3 800	000	31.504	.803	1.11	0.41
3 900	000	32.307	.800	1.12	0.40
4 000	000	33.107	.799	1.14	0.39
4 100	000	33.906	.796	1.15	0.38
4 200	000	34.702	.794	1.16	0.37
4 300	000	35.496	.792	1.18	0.36
4 400	000	36.288	.790	1.19	0.35
4 500	000	37.078	.787	1.20	0.35
4 600	000	37.865	.785	1.22	0.34
4 700	000	38.650	.782	1.23	0.33
4 800	000	39.432	.780	1.24	0.33
4 900	000	40.212	.778	1.25	0.32
5 000	000	40.990	.774	1.26	0.31
5 100	000	41.764	.773	1.28	0.31
5 200	000	42.537	.769	1.29	0.30
5 300	000	43.306	.767	1.30	0.30
5 400	000	44.073	.764	1.31	0.29
5 500	000	44.837	.761	1.32	0.29
5 600	000	45.598	.758	1.33	0.28
5 700	000	46.356	.756	1.35	0.28
5 800	000	47.112	.752	1.36	0.27
5 900	000	47.864	.750	1.37	0.27

★ F CORRECTION NOT REQUIRED

N	C	DIFF IN C	ALLOWABLE DIFF IN N	F
6 000 000	48.614	.746	1.38	0.26
6 100 000	49.360	.743	1.39	0.26
6 200 000	50.103	.740	1.40	0.26
6 300 000	50.843	.737	1.41	0.25
6 400 000	51.580	.734	1.42	0.25
6 500 000	52.314	.730	1.43	0.25
6 600 000	53.044	.727	1.44	0.24
6 700 000	53.771	.724	1.45	0.24
6 800 000	54.495	.720	1.46	0.24
6 900 000	55.215	.717	1.47	0.23
7 000 000	55.932	.713	1.48	0.23
7 100 000	56.645	.710	1.49	0.23
7 200 000	57.355	.706	1.50	0.22
7 300 000	58.061	.702	1.51	0.22
7 400 000	58.763	.699	1.52	0.22
7 500 000	59.462	.695	1.52	0.22
7 600 000	60.157	.691	1.53	0.21
7 700 000	60.848	.688	1.54	0.21
7 800 000	61.536	.683	1.55	0.21
7 900 000	62.219	.680	1.56	0.21
8 000 000	62.899	.675	1.57	0.20
8 100 000	63.574	.672	1.58	0.20
8 200 000	64.246	.668	1.59	0.20
8 300 000	64.914	.664	1.59	0.20
8 400 000	65.578	.659	1.60	0.20
8 500 000	66.237	.656	1.61	0.19
8 600 000	66.893	.651	1.62	0.19
8 700 000	67.544	.647	1.63	0.19
8 800 000	68.191	.643	1.63	0.19
8 900 000	68.834	.638	1.64	0.19
9 000 000	69.472	.634	1.65	0.18
9 100 000	70.106	.630	1.66	0.18
9 200 000	70.736	.625	1.66	0.18
9 300 000	71.361	.621	1.67	0.18
9 400 000	71.982	.616	1.68	0.18
9 500 000	72.598	.612	1.69	0.18
9 600 000	73.210	.608	1.69	0.17
9 700 000	73.818	.602	1.70	0.17
9 800 000	74.420	.598	1.71	0.17
9 900 000	75.018	.594	1.71	0.17
10 000 000	75.612	.588	1.72	0.17
10 100 000	76.200	.584	1.73	0.17
10 200 000	76.784	.579	1.74	0.17
10 300 000	77.363	.575	1.74	0.17
10 400 000	77.938	.569	1.75	0.16
10 500 000	78.507	.565	1.75	0.16
10 600 000	79.072	.560	1.76	0.16
10 700 000	79.632	.554	1.77	0.16
10 800 000	80.186	.550	1.77	0.16
10 900 000	80.736	.545	1.78	0.16
11 000 000	81.281	.539	1.79	0.16
11 100 000	81.820	.535	1.79	0.16
11 200 000	82.355	.530	1.80	0.16
11 300 000	82.885	.524	1.80	0.15
11 400 000	83.409	.519	1.81	0.15
11 500 000	83.928	.514	1.82	0.15
11 600 000	84.442	.509	1.82	0.15
11 700 000	84.951	.503	1.83	0.15
11 800 000	85.454	.498	1.83	0.15
11 900 000	85.952	.493	1.84	0.15
12 000 000	86.445	.488	1.84	0.15

N			C	DIFF IN C	ALLOWABLE DIFF IN N	F
12	100	000	86.933	.482	1.85	0.15
12	200	000	87.415	.477	1.85	0.15
12	300	000	87.892	.471	1.86	0.15
12	400	000	88.363	.466	1.86	0.14
12	500	000	88.829	.460	1.87	0.14
12	600	000	89.289	.455	1.87	0.14
12	700	000	89.744	.449	1.88	0.14
12	800	000	90.193	.444	1.88	0.14
12	900	000	90.637	.438	1.89	0.14
13	000	000	91.075	.432	1.89	0.14
13	100	000	91.507	.427	1.90	0.14
13	200	000	91.934	.421	1.90	0.14
13	300	000	92.355	.416	1.91	0.14
13	400	000	92.771	.409	1.91	0.14
13	500	000	93.180	.404	1.91	0.14
13	600	000	93.584	.399	1.92	0.14
13	700	000	93.983	.392	1.92	0.14
13	800	000	94.375	.386	1.93	0.14
13	900	000	94.761	.381	1.93	0.13
14	000	000	95.142	.375	1.94	0.13
14	100	000	95.517	.369	1.94	0.13
14	200	000	95.886	.363	1.94	0.13
14	300	000	96.249	.357	1.95	0.13
14	400	000	96.606	.352	1.95	0.13
14	500	000	96.958	.345	1.95	0.13
14	600	000	97.303	.339	1.96	0.13
14	700	000	97.642	.333	1.96	0.13
14	800	000	97.975	.328	1.96	0.13
14	900	000	98.303	.321	1.97	0.13
15	000	000	98.624	.315	1.97	0.13
15	100	000	98.939	.309	1.97	0.13
15	200	000	99.248	.303	1.98	0.13
15	300	000	99.551	.297	1.98	0.13
15	400	000	99.848	.290	1.98	0.13
15	500	000	100.138	.285	1.99	0.13
15	600	000	100.423	.278	1.99	0.13
15	700	000	100.701	.273	1.99	0.13
15	800	000	100.974	.266	1.99	0.13
15	900	000	101.240	.259	2.00	0.13
16	000	000	101.499	.254	2.00	0.13
16	100	000	101.753	.247	2.00	0.13
16	200	000	102.000	.241	2.00	0.12
16	300	000	102.241	.235	2.01	0.12
16	400	000	102.476	.229	2.01	0.12
16	500	000	102.705	.222	2.01	0.12
16	600	000	102.927	.216	2.01	0.12
16	700	000	103.143	.209	2.02	0.12
16	800	000	103.352	.204	2.02	0.12
16	900	000	103.556	.196	2.02	0.12
17	000	000	103.752	.191	2.02	0.12
17	100	000	103.943	.184	2.02	0.12
17	200	000	104.127	.178	2.03	0.12
17	300	000	104.305	.171	2.03	0.12
17	400	000	104.476	.165	2.03	0.12
17	500	000	104.641	.159	2.03	0.12
17	600	000	104.800	.152	2.03	0.12
17	700	000	104.952	.146	2.03	0.12
17	800	000	105.098	.139	2.04	0.12
17	900	000	105.237	.133	2.04	0.12
18	000	000	105.370		2.04	0.12



FM 6-300

29 SEPTEMBER 1978

By Order of the Secretary of the Army:

BERNARD W. ROGERS
General, United States Army
Chief of Staff

Official:

J. C. PENNINGTON
Brigadier General, United States Army
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